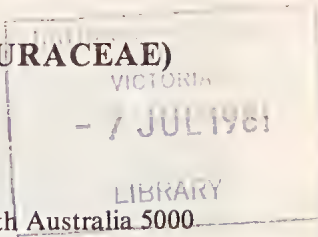


A TAXONOMIC REVISION OF *CASSYTHA* (LAURACEAE) IN AUSTRALIA

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Abstract

The taxonomy of the genus *Cassytha* L. (Lauraceae) in Australia is revised: in Australia there are 14 species, 3 varieties and 5 forms, all of them endemic except *C. filiformis*, *C. capillaris* and *C. pubescens*. The following new taxa are described: *Cassytha aurea*, *C. pedicellosa*, *C. peninsularis*, *C. rufa*, *C. aurea* var. *candida*, *C. aurea* var. *hirta*, *C. peninsularis* var. *flindersii* and *C. glabella* f. *bicallosa*.

New combinations are: *Cassytha glabella* f. *casuarinae* (Nees) J.Z. Weber (*C. casuarinae* Nees), *C. glabella* f. *dispar* (Schltdl.) J.Z. Weber (*C. dispar* Schltdl.), *C. racemosa* f. *muelleri* (Meisn.) J.Z. Weber (*C. muelleri* Meisn.), *C. racemosa* f. *pilosa* (Benth.) J.Z. Weber (*C. racemosa* var. *pilosa* Benth.).

An introduction includes discussion of morphology and includes the first chromosome count for a species of *Cassytha* (*C. pubescens*: n = 24).

The affinities of the species are discussed, their distribution described, a key to the species, varieties and forms provided and a revised description of each taxon is supplemented with drawings, distributions maps and comment on possible evolutionary trends.

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Introduction

Species of *Cassytha* share a remarkable similarity of morphology and habit with *Cuscuta* (Convolvulaceae), but considerable differences in flower, fruit, physiological and anatomical features show that this similarity is only a case of convergent evolution to a parasitic habit. There is a notable uniformity in morphology throughout the genus *Cassytha* and the number of distinct species in the world is small (1, 2 or 3), except in Australia where fourteen species occur.

The major systematic treatment of *Cassytha* on a world wide basis was by Meisner (1864), dealing with 29 species; Bentham (1870) revised Australian *Cassytha* and recognized 11 species. Since Bentham only two new species and two varieties have been described for Australia although numerous collections have been made throughout the country. Later floras dealt with only part of the area, e.g. Blackall & Grieve (1954) eight species from Western Australia; Beadle (1972) six from north-eastern New South Wales; Willis (1972) five from Victoria; Beadle, Evans & Carolin (1972) four from the Sydney Region and Black (1948) three from South Australia. Old keys and descriptions are inadequate for a number of species occurring in Australia and a new approach was needed to reassess the taxa.

In the introductory historical review, references to type descriptions of species described outside Australia are fully cited as I have seen only the relevant parts and not the entire publications in which these taxa were described. I have not dealt with these non-Australian taxa in full, have not seen most of the types and have accepted the published views of other authors. For Australian species full references are provided as I have seen all the relevant publications. All specimens cited have been examined.

Brief History of Taxonomy of *Cassytha*

Linnaeus (1753, p. 35) first validated *Cassytha* as a generic name, which had been previously proposed in letters written by Osbeck from China. Linnaeus placed the genus and a single species (*C. filiformis*) in his Triandria Monogynia, although this species has 6 or 9 but never only 3 fertile anthers and *Laurus*, to which it has subsequently been shown to be closely related, has 9 stamens and was correctly placed in the Enneandria Monogynia.

N.L. Burman in 'Fl. Ind.' 93, t. 23, f. 1 (1768) described a new "*Cassytha*" from Java, placing it in the group of "Enneandria Monogynia". The specimen was described as having a woody stem, with a curved, horn-like appendage at each node and linear-lanceolate leaflets. Linnaeus (1771, p. 237) cited Burman's "*C. corniculata*" with *Laurus culilaban* presumably not seeing a specimen of the former. Nees (1866, p. 649) also listed *C. corniculata*, mistakenly attributed to Linnaeus, but listed it as being a dubious specimen. Eventually, Meisner (1864, p. 258) excluded it from the Lauraceae, and Kostermans in 'J. Sci. Res. Indon.' 1: 85, 94 (1952) recognized it as belonging to the Cactaceae.

Eleven years later "*Cassytha baccifera*" was described from India by Solander ex Miller in 'Illustratio Systematis Sexualis Linnaei', in Classis IX. Ordo I (1777) followed by the plate with the same enumeration and title. The description and drawing do not match the features of *Cassytha*, clearly showing trilobate anthers. Rumphler in Forster, 'Handb. Cacteenk.' 458 (1846) redetermined it as being *Cactus pendulus*.

From Sri Lanka, *C. zeylanica* was described by J. Gaertner in 'Fructus' 1: 134 (1788) but later included by Kostermans (1950, p. 85) in the synonymy of *C. filiformis*.

Jussieu (1789, p. 80) was first to describe the family Lauraceae ("Ordo VI. Lauri"), appending *Cassytha* to the list of genera on the basis of affinities in floral characters but drawing attention to its very different habit, resembling more closely that of *Cuscuta* (Convolvulaceae).

From Africa, Thunberg in 'Prod. Pl. Cap.' 78 (1794) described "*C. filiformis*" nom. illeg., which was put by Nees (1836, p. 645) in the synonymy of *C. glabella* R.Br. However, the present author believes that *C. glabella* is an exclusively Australian species, and the two collections in the Thunberg Herbarium [UPS (9847 & 9848)], seen only on microfiche, may belong to *C. ciliolata* Nees.

From Arabia, *C. aphylla* was described by Raeuschel in 'Nom. Bot.' ed. 3: 116 (1797) but it was put by Kostermans (1950, p. 85) in synonymy with *C. filiformis* L.

Ventenat (1799, pp. 245, 246), in dealing with the Order "Les Laurinees, Laurinae", includes the genus *Laurus*, but *Cassytha* received no mention.

From America, Miller ex Swartz in 'Fl. Ind. Occ.' 2: 876 (1800) described *C. polysperma*, which was placed by Kunth, in 'Feddes Rep. Beih.' 43: 314 (1928), in synonymy with *C. americana* Nees (the latter being treated by most authors, for example Stapf (1912) and Kostermans (1950), as *C. filiformis* L.).

Later, Brown (1810, p. 401) adopted the order name LAURINAE which he attributed to Ventenat, with Jussieu's Lauri as a synonym. Here he placed four genera, including

Cassytha with four newly described species from Australia. The descriptions were based mainly on his collections made from 8.xii.1801 to mid-1805.

From "Danish Guinea" (Ghana) *C. pubescens* was described by Schumacher ex Hornemann in 'De Indole Pl. Guineensis Observ.' 13 (1819) nom. nud. et illeg., but Junghans in 'Botan. Tidsk.' 57: 340 (1962) states "The MS confirms that the epithets, "guineensis" (1827) and "pubescens" are based on the same material". (See comment below on *C. guineensis* (1827)).

Nees in Wallich (1831, pp. 58-76), dealing with the "Order Laurinae" sensu Jussieu, listed 20 genera; *Cassytha* was included with 10 other genera in the group having fertile stamens of the fourth (innermost) whorl with unilocular anthers. In the meantime, Bartling (1830, p. 112) discussed the difference in habit of *Cassytha* from other genera in the Laurinae, but retained it there.

From Africa, Schumacher in 'Beskr. Pl.' 199 (299) (1827), described *C. guineensis*, which Stapf (1913, p. 188) placed in synonymy with *C. filiformis* L.

Subsequently, Lindley (1833, p. 112) segregated the Cassytheae from the Laurinae as leafless, herbaceous and tasteless (non-aromatic); incorrectly ascribing the former name to Bartling. This has been accepted later as the type description of the family Cassythaceae, the suffix being corrected to conform with the requirements of the International Code of Botanical Nomenclature. The name Cassythaceae Bartl. ex Lindl. has since been conserved.

In the same year as Lindley, Nees (1833, pp. 19-20) published his arrangement of the "Order Laurales" (footnote, p. 20), dividing it into two tribes, and the tribe "Laureae" into three groups, the last of these being the "Cassytheae". Three years later, in his monograph on the Laurales (1836, pp. 1-720) Nees subdivided the Lauraceae into thirteen tribes with 34 genera, where *Cassytha* was treated in "Tribus XIII. Cassytheae". In the treatment nine species were listed, one new one being described from America, one new species from South Africa and a new variety of *C. filiformis* (which received no name) from Java and Malaya.

Later Endlicher (1836, pp. 258 & 315) accepted the division by Nees (1836) but described the location of "Tribe XIII. Cassytheae" in "Laurineae" as dubious and bad.

Lindley (1836, p. 202) described the family Cassythaceae as distinct from the family Lauraceae, drawing his conclusion from data provided by Nees (1833), saying "There are distinctions enough even in the fructification to define Cassythaceae as a peculiar order" and he considered that *Cassytha* has "The general structure of Lauraceae, but: the stem dodder-like, parastitital, leafless". In his later publication on *Cassytha* (1846, pp. 535-538) he retained it next to the "Order CCV. Lauraceae,—Laurales" but still as a separate order "CCVI, Cassythaceae".

Shortly before, Meisner (1841, 324, Comm., p. 237) had included in the Order Laurinae 2 suborders, one being the monogeneric Cassytheae, the other the Laureae with 12 tribes and 31 genera.

From Africa four *Cassytha* species were recorded by E. Meyer in Drege, 'Zwei Pfl. Docum.' (1844), as follows: *C. glabella*, *C. triflora*, *C. rubiginosa* and *C. pubescens* all without authorities and nom. nud. On p. 171 they were listed alphabetically with authorities but again without description. Stapf (1912, p. 501-502) placed *C. glabella* sensu E. Meyer (not R. Br.) and *C. triflora* E. Meyer under synonymy of *C. ciliolata* Nees, put *C. pubescens* sensu E. Meyer (not R. Br.) and *C. rubiginosa* E. Meyer in synonymy with *C. pondoensis* Engl.

Nees in Lehmann (1845, pp. 619-622), attributed authorship of the order "Laurineae" to Endlicher, as well as of the "Tribe XIII. Cassytheae"; and of the suborder "I. Cassytheae"

to Meisner. Here were described seven new species of *Cassytha* from Western Australia, based on the collections of L. Preiss, made between 1838-1840. He placed them in two groups having the perianth urceolate or rotate, a view with which Bentham (1870) "could not concur".

Two years later Schlechtendahl in 'Linnaea' 20 (5): 577 (1847) described from Australia a new species, *C. pubescens* and, on p. 578, another, *C. dispar*. One year later, again in 'Linnaea' 21: 444, he renamed *C. pubescens* (non. R. Br.) as *C. piligera* Schldl., which was subsequently put by Bentham (1870) into synonymy of *C. pubescens* R. Br., where I have retained it. *C. dispar* was put by Bentham (1870) in synonymy with *C. glabella* R. Br., but I have made it a form of *C. glabella*.

The second contribution by Meisner appeared in De Candolle (1864, pp. 1-260), where the "Order" Lauraceae was divided into three suborders: suborder 2 Gyrocarpeae, which is now in the family Hernandiaceae; suborder 1 Laurineae; and the monogeneric suborder 3 Cassytheae. Kostermans (1957, p. 220) regards these last two as sub-families. Although Meisner combined several of Nees' genera, he still accepted four tribes with 46 genera. Each tribe was accompanied by a diagnosis. In the treatment of *Cassytha* (pp. 252-258), he dealt with 29 species, fourteen of them and seven varieties being newly described. From Australia 25 species and one variety were recognized; twelve species and one variety were new. The genus was subdivided according to the inflorescence being capitate, spicate, racemose or umbellate, each taxon being provided with a description. The diagnoses of Australian taxa were based mainly on specimens from Hooker's Herbarium, to a lesser extent on those in Boissier's and on the collections of De Candolle, Drummond, Gunn, Harvey, Mueller and Sieber. There is no evidence that he saw R. Brown's original herbarium which was, at that time, in Bennett's care at the British Museum.

Two years later Mueller (1866, p. 167) dealt with seven genera in the "Laurinae", one of them being *Cassytha*, which was represented by five species and a new variety; the variety, *C. paniculata* var. *phaeolasia*, was four years later raised to species rank by Bentham.

Bentham (1870, pp. 293-315) provided a comprehensive account of the known Australian Order "Laurineae". He also established three suborders which differ from Meisner's; "Laureae" with six genera, the monogeneric "Cassytheae" with *Cassytha* and "Hernandieae" now in the family Hernandiaceae. A key was provided to suborders and genera, as well as a separate key to the species. In his treatment of *Cassytha* in Australia he recognized 11 species and three varieties; two varieties were newly described. Eight of Meisner's species were reduced to synonymy, one being retained as a variety and one listed as a dubious species.

Three of Nees' and two of Schlechtendahl's species were also included in synonymy. Mueller's variety was raised to species rank. For distinguishing species the characters used in the key were type of inflorescence, indumentum and stamens. He recognised the difficulties in the identification of some species before the fruits mature and pointed out the error of Meisner and Nees in describing different forms as distinct species. In the discussion on Lindley's proposal to place *Cassytha* in a distinct natural order he stressed (p. 308) "The structure of the flower is so precisely that of *Cryptocarya*, that it has been reunited with Laurinae". Bentham in Bentham & Hooker (1880) employed the same classification except that he termed the subdivisions "tribes" and not suborders.

From Central America, *C. dissitiflora* was described by Meisner, 'Kjoeb. Vidensk. Meddel.' 145 (1870), but it was later placed by Kostermans (1950, p. 85) in synonymy with *C. filiformis* L.

From the Philippines *C. capillaris* was described by Fernandes-Villar, 'Nov. App.' 182

(1880), a nom. illegit. and reduced to synonymy by Merrill, 'Enum. Philip. Fl. Pl.' 2: 204 (1923), under *C. filiformis* L.

Tepper (1888) described *C. tepperana* from Kangaroo Island (South Australia); I have placed it in synonymy with *C. pubescens* R. Br.

Pax in Engler & Prantl (1889, p. 124) produced a general monograph where he based his classification of the Lauraceae on the number of stamens and anther cells. The Lauraceae was divided into two subfamilies, 1. Persoideae and 2. Lauroideae. The genus *Cassytha* was placed in the Lauroideae—Cassytheae along with four other subdivisions of the Lauroideae. Kostermans (1957, p. 221) mentioned that Dadswill & Eckersley (1940) and Desch (1941), accepted Pax's subdivision into Lauroideae and Persoideae.

From Africa *C. pondoensis* was described by Engler in 'Bot. Jahrb.' 26: 392 (1899). From Timor *C. timoriensis* was described by Gandoger in 'Bull. Soc. Bot. France' 60: 419 (1913) based on a collection made by Zippel (1865). I have seen the type collection and determined it as being *C. filiformis* L.

A new species from Australia *C. strigosa* was described by Fitzgerald in 'J. Roy. Soc. W. Austral.' 3: 143 (1918) based on his own collection made in 1913. I have put it in synonymy with *C. capillaris* Meisn. (1864).

For New Caledonia, "*Cassytha lifuensis*" and "*C. macrocarpa*" were described by Guillaumin in 'Bull. Soc. Bot. France' ser. 4 (24): 1103 (1924), but this is a typographic error and the generic name should read *Cryptocarya*.

Domin (1925, pp. 674-680) in his classification of Lauraceae, included *Cassytha* with four other genera and described for Australia a new variety *C. filiformis* var. *pseudopubescens* based on his collection from southern Queensland made in 1909-1910. However, I have reduced this variety to synonymy with *C. filiformis*.

From Africa, *C. senegalensis* was described by Chevalier, 'Fl. Viv. Afric. Occ. France' 1: 46 (1938), but it was reduced to synonymy with *C. filiformis* L. by Hutchinson & Dalziel (1954).

From New Guinea, *C. archboldiana* and *C. tenuis* were described by Allen (1942, p. 155) based on collections made by Brass (1936-1938); I have put the former into synonymy with *C. filiformis* L. and the latter into synonymy with *C. capillaris* Meisn. (1864).

Another species *C. novo-guineensis*, was described from New Guinea by Kanehira and Hatushima in 'Bot. Mag. (Tokyo)' 57 (677): 190 (1943) based on their collection made in West Irian (1940). I have put it in synonymy with *C. filiformis* L.

From Africa, *C. schliebenii* was described by Robyns and Wilczek in 'Bull. Jard. Bot. Etat Bruxelles' 19: 506 (1949) based on a collection made by Schlieben in Tanganyika (1931).

Kostermans (1957a) revised the Lauraceae, describing two subfamilies, Lauroideae and Cassythoideae, the latter with a single genus. The characters used were principally whether arborescent with "normal" leaves or climbers without "proper" leaves. This classification was confirmed in his second publication (Kostermans, 1957b).

Within the Lauraceae, Sastri (1962) considered that "On embryological grounds there is not sufficient evidence to remove *Cassytha* to a separate family". Hutchinson (1964) retained *Cassytha* in the Lauraceae, in tribe 6. Cassytheae. Hegnauer (1966, p. 351), in his chemotaxonomic study in Lauraceae, produced a system rather similar to that of Pax (1889), placing the monogeneric subtribe Cassytheae in subfamily Lauroideae. Pax's system was regarded by Kostermans (1957) as very artificial.

During the period that has elapsed since the publication of the most comprehensive

treatment of the Australian Laurales (Bentham, 1870), most Australian systematists have treated *Cassytha* as a genus within the family Lauraceae, but Beadle, Evans & Carolin (1963 & 1972) recognized the monogeneric Cassythaceae.

In the brief accounts in floras of areas other than Australia, systematists (Stapf in Thiselton-Dyer, 1912 & 1913; Kostermans, 1950; Hutchinson & Dalziel, 1954; Takhtajan, 1959; Gooding, Loveless & Procter, 1965; Ching-En Chang, 1967; Cronquist, 1968) have mostly treated *Cassytha* as a genus of the family Lauraceae, but Britton & Millspaugh (1962) place it into Cassythaceae Dumont.

Sastri (1962, p. 205), discussing the systematic position of *Cassytha* and how it differs from other genera of Lauraceae, listed ten features which are common with the majority of other members so far studied. He continues, "*Cassytha* also shows some distinctive features which are not shared by other members of Lauraceae", and also, "The four points of difference mentioned above do not seem to be so significant as to warrant the removal of *Cassytha* from the Lauraceae". He stated that in his classification he agrees with Meisner, Mez, and Bentham and Hooker in assigning the genus *Cassytha* to a separate suborder or tribe. A year later Sastri (1963, p. 428) concluded that there is no justification for removing *Cassytha* from Lauraceae into a separate monogeneric family as suggested by Lindley (1853) and certain later authors (Sastri, 1962).

In this revision, I treat *Cassytha* as a genus of the family Lauraceae, the position first given by Jussieu (1789).

Taxonomic Criteria

Morphology

Habit

All species of *Cassytha* are at maturity rootless, perennial, herbaceous, chlorophyllous, obligate parasites, lacking tendrils but attached to their hosts by haustoria along the stems.

Anatomy

Comparatively little work had been done on the floral anatomy of the Lauraceae until Sastri (1952, 1962 & 1963). He made a detailed study of the floral anatomy of *Cinnamomum inners* Reinw. and *Cassytha filiformis* L. (Sastri, 1952, pp. 241-243).

Stems

The thread-like stems or branchlets have a diameter of 1-3 mm and branch profusely and monopodially, as they twine around the host or each other. The younger branchlets may be greenish in colour from chlorophyll but eventually may become green-black to orange-red. Unlike certain other parasitic plants there is no mimicry of the host, nor does the host influence the colour of the parasite. The unexposed parts of the stem, as well as the fruits, commonly remain green, even after drying.

A prominent feature of the stem is the development of rugae on the surface, these rugae becoming exaggerated in drying. Although I consider the rugae to be too variable and to show too much gradation between forms to be used as a taxonomic character, it was used by Ludwig (MS) and later Tepper (1888) to distinguish *C. tepperana* from *C. pubescens*. These are now considered synonymous. This development of rugae is particularly prominent in forms of *C. pubescens* from parts of Eyre Peninsula and Kangaroo Island, in South Australia, and from the Blue Mountains in New South Wales.

The only stem character I have used in distinguishing taxa is the indumentum, which is dealt with separately.

Dealing with anatomy of the stem in *Cassytha filiformis* L., Kostermans (1957,

p. 246) described the epidermis as consisting of heavily cutinized, square cells, with stomata in rows and pores at right angles to the axis. The outer part of the cortex has 1-6 layers of rounded, rather small cells and the endodermis is not differentiated at an early stage. The phloem is situated in the form of strands in furrows in the outer periphery of the xylem. The xylem forms a continuous cylinder, internally bounded by groups of protoxylem which extend into the pith. However, the vessels of the secondary wood are larger and reach 120 μm or more in diameter.

Haustoria

The haustoria are 1-2 mm in diameter, sometimes more, and single or in a series (to eight or more) formed on contact with a host. They are rarely only wart-like, not reaching the host, and often observed as adhering to their own stem-branchlet. Adherence and actual connection with the host plant is, according to Schroeder (1978, p. 126), by means of the development through the haustoria of internal anatomical continuity of the xylem from the parasite to the host plant.

B.G. Beaman (n.v., summarised in 'Dissertation Abstracts International' V. 32 (1972) 5644-B), investigated 5 species of *Cassytha*, where the haustoria were studied in terms of their origin and found to consist of two distinct parts, an attachment cup and a penetration wedge, each arising from separate meristematic areas of the parasite stem. Furthermore, the comparative studies of the stem and mode of parasitism revealed "There is no anatomical justification for the removal of *Cassytha* from the Lauraceae into separate monogeneric family". He also stated "Anatomically, *Cassytha* is very homogenous".

Indumentum

The hairs, where present, are simple, transparent, pale grey to black or red, with microscopic black or red particles providing the colour. The indumentum on petals and fruits is typical and constant for each taxon except *C. pubescens*. The stems and branches vary from glabrescent to pubescent in the same species and even on a single plant.

Leaves

Leaves in the family Lauraceae usually have a well developed lamina and petiole, are exstipulate and spirally arranged. In *Cassytha* the lamina and petiole are reduced; the *scaly leaves* measuring 0.5-5 mm long and lacking chlorophyll. Phyllotaxis is 1/3, compared with 2/5 and 3/8 recorded for other members of the Lauraceae.

In all species of *Cassytha* with triangular leaves and in some with ovate, the leaves are sessile and basifixed. A few species have ovate, shortly petiolate leaves consisting of an *anterior lamina* with a single unbranched vein (Fig. 1) and a *posterior lamina* which is not vascular and appears to be a secondary development in the evolution of this form of leaf. Leaves of this latter type are referred to as "peltate" in the text. The anterior portion of the leaf is fleshy in both forms, but below the point of attachment of ovate leaves the lamina is thinner. Leaves of all northern Australian species, for example, *C. filiformis* and *C. capillaris* are triangular to ovate and basifixed, while many southern species (*C. peninsularis*, *C. pomiformis*, *C. pubescens* and *C. racemosa* but not its f. *muelleri*) have peltate leaves. It is possible that the posterior thinner part was formed by a fusion of hastate lobes or spurs, although such lobes are not known to occur in the Lauraceae. Alternatively the posterior lobe may constitute a new structure resulting from an outgrowth from the leaf or the migration of the petiole from the base of the lamina. Its absence from the other members of the Lauraceae suggests that it is an 'advanced' character. Only in distinguishing the forms of *C. racemosa* has this character been found to contrast enough for its use taxonomically.

Most species have hairy leaves, but the hairs are usually (perhaps always) confined to

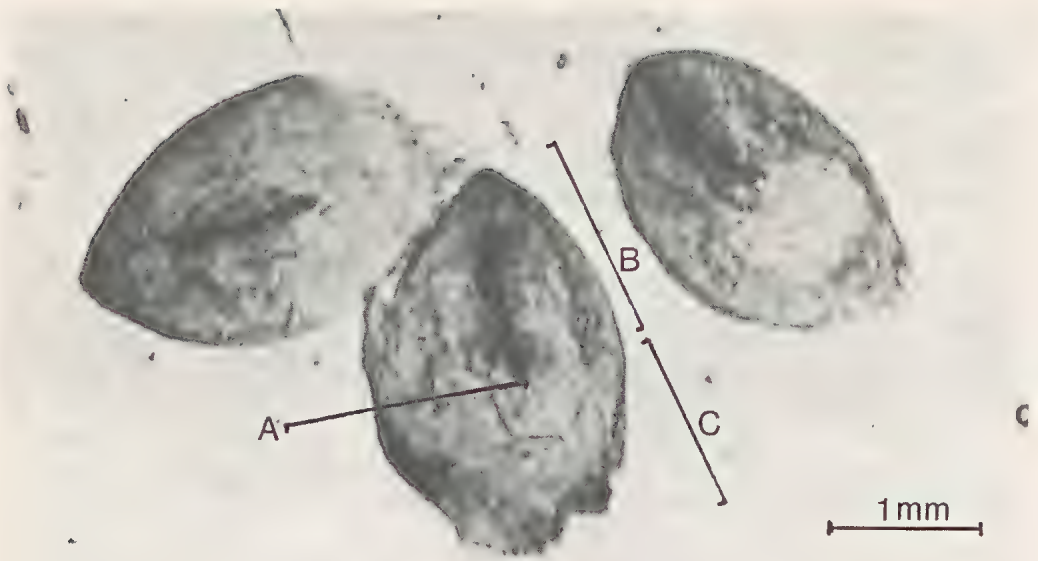


Fig. 1. Peltate leaves of *Cassytha pubescens*. A, place of attachment; B, anterior lamina with simple vein; C, posterior lamina with cilia.

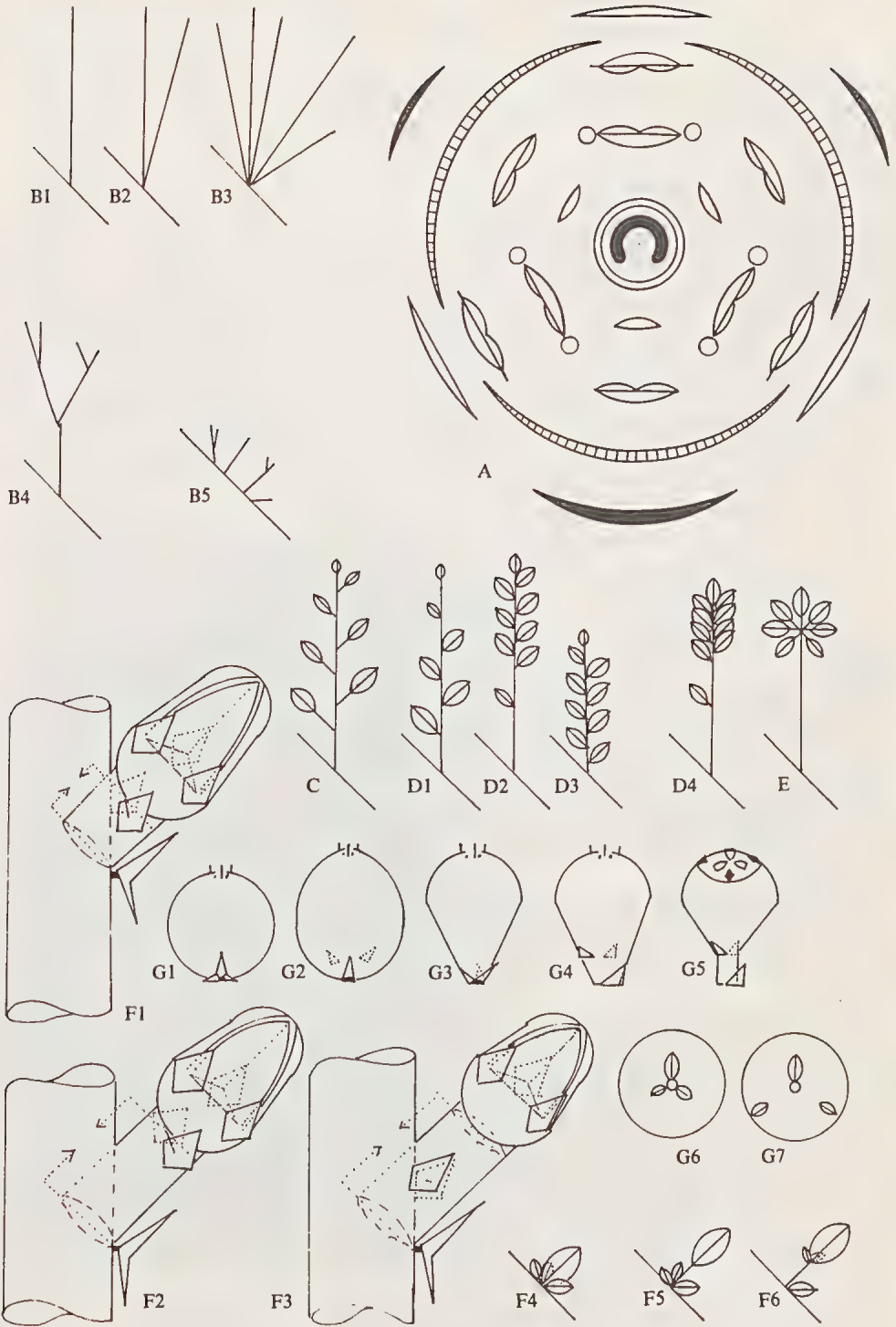
the upper surface. The hairs are often spread centrifugally from the centre of the lamina, are all retrorse, or are confined to the margin of the leaf. There is frequently a gland on the upper surface in the central portion of the lamina, commonly with a transverse saddle in the middle (see Fig. 21, O); it is pubescent or glabrous. Although usually occurring on all the leaves of an individual, plants with and plants without both occur in a species and, as such, this attribute has no taxonomic value.

Inflorescence

The inflorescence is always axillary. The basic unit is a (mostly short) spike, rarely a raceme, seldom a panicle (see Fig. 2, B1-5 & C), and usually thinner than the branches but with a denser indumentum (except in *C. glabella* which is glabrous). Flowers may be loosely arranged along the axis, or congregated in a loose or congested head or umbel (see Fig. 2, D1-4 & E). The head may be quite sessile forming a glomerule, or on a long or short peduncle.

Bracts: There is an axillant bract with two smaller bracteoles at the base of each peduncle and each of its branches. At the base of each pedicel is a bract, referred to in the text as the "floral bract", inserted at the attachment of the pedicel to the peduncle (see Fig. 2, F1-6). In addition there are two usually smaller bracteoles, referred to in the text as the "floral bracteoles". If the bracteoles are at the base of a short pedicel (not exceeding 0.3 mm), in one plane with the bract ("verticillate") and entirely concealing the pedicel, the flower is

Fig. 2. Diagrams of *Cassytha* inflorescence types and floral parts. A, floral diagram. B, inflorescence arrangements: B1, single; B2, paired; B3, fasciculate; B4, paniculate; B5, glomerulate. C, raceme. D, spike types: D1-3, loose; D2, elevated; D3, sessile; D4, congested. E, umbel. F, floral bract arrangements: F1 & 4, sessile with verticillate bracts; F2,3,5,6, pedicellate; F2 & 6, pedicellate, floral bracts in two planes, bracteoles supporting the flower; F3 & 5, pedicellate with floral bracts verticillate at the base of the pedicel. G, fruits: G1 & 6, globose and sessile with verticillate floral bracts; G2 & 7, ovoid and pedicellate with floral bracts in two planes; G3 & 6, pyriform and sessile with verticillate floral bracts; G4 & 7, pyriform and pedicellate with floral bracts in two planes; G5 & 7, pyriform and pedicellate, pedicel cylindrical, floral bracts in two planes; G6, floral bracts verticillate (viewed from below); G7, floral bracts in two planes (viewed from below).



then termed "sessile" (see Fig. 2, F1 & 4). In "pedicellate flowers" the pedicel is visible, exceeding the axillant bract. Rarely, in species with pedicellate flowers, as in *C. pomiformis*, the bracteoles are verticillate (see Fig. 2, F3 & 5). Or the bracteoles may be remote from the bract when the floral bracts are referred to in the text as being "in two planes"; the bracteoles close to the flower and with their bases flanking the pedicel (see Fig. 2, F2 & 6).

Flowers

Perianth: Bentham (1870), in describing the flower of *Cassytha*, used the term "perianth" for all six segments, three outer and three inner. Mez, in 'Jahrb. Kgl. Bot. Gart. Berlin' 5 (1889), "Stressed the apetalous nature of the (Lauraceae) flower by pointing at *Cassytha*" (cited by Kostermans, 1957, p. 14) with which the latter author agreed, terming all the segments "tepals" (l.c. p. 53). The flower shows a P_{3+3} , $A_{3+3+3+3}$, G_1 arrangement and, according to anatomical investigations (Kostermans, 1957, p. 13), the two perianth whorls appear simultaneously (l.c. p. 13). The present author, contrary to Kostermans, terms members of the outer whorl sepals and the inner petals to distinguish these rather distinct whorls, as did Rendle (1938) and Saunders (1939), cited by Sastri (1952, p. 243).

Sepals: The sepals resemble floral bracts in size, shape and indumentum if present and are occasionally treated by some authors as representing a transition from bracts to sepals. They are furnished with one central vascular bundle (Sastri, 1952, p. 243). At the flowering stage they are more fleshy than leathery and usually situated close to the floral bracts, especially to the bracteoles; in fruit they are leathery and elevated, with the petals at the top of the enlarged receptacular tube, remote from the bracts.

Petals: The petals at flowering are fleshy and triangular, occupying most of the flower; they are furnished with three vascular bundles included in a broad ring of parenchymatous tissue (Sastri, 1952, p. 243). At first they are green, later in flower they may turn slightly yellow-green or red-green and in fruit become leathery, brown to black, spreading, erect or inturred and more or less closing the orifice. Seldom does the margin differ from the rest of the lamina in having a rim slightly yellower or red (more conspicuous when dry) or in lacking the pubescence as in *C. melantha*. The petals, in flower, appear as a continuation of the receptacular tube, at first always green, glabrous or pubescent on both or only one surface, or rarely papillose inside as in *C. glabella* f. *bicallosa*.

Receptacular tube: The receptacular tube is very short in the flower. It is glabrous or pubescent outside and/or inside, and in most species it is concealed by the floral bracts at the flowering stage. See description of fruit for subsequent development of the receptacular tube.

Stamens: The primitive Laurales are thought to have had four-celled anthers (Kostermans, 1957), but in *Cassytha* they are two-celled, each cell with one flap. Of the four whorls of the androecium, the first second and fourth are supplied by single vascular bundles and only the third is supplied with three bundles which bear the lateral glandular outgrowths. In the stamens of the third whorl the bundles pass to the lateral glands at the base of the filaments. According to Sastri (1952, p. 245) "Saunders (1939) is of the opinion that the stamens in the family are the result of chorosis; Reece (1939), on the other hand, favours the view that they are derived by reduction from an original branch system." *Cassytha* is generally considered to have undergone greater androecial reduction than other genera (e.g. *Cinnamomum* and *Persea*). The filaments are usually narrower than the anthers, but in the stamens of the first (outer) whorl are often expanded laterally and are nearly half as wide as long and, in Australian species, frequently apiculate. In the cell of the young anther the primary archesporium consists of a hypodermal layer five to six cells wide according to Sastri (1962, p. 197). These cells divide periclinally and form a tapetum

of which the cells become two-nucleate and later divide meiotically. As a result of mitotic divisions in the primary sporogenous cells about a hundred microspore-mother-cells are formed in each anther lobe.

Pollen: According to Sastri (1962, p. 197), the pollen tetrads are tetrahedral or isobilateral in *C. filiformis*, *C. pubescens* and *C. glabella* which he studied. Mature pollen grains are two-celled, acolpate and filled with fat globules. They are usually shed when the ovules are at the megaspore-mother-cell stage. They measure about 40 μm diameter in *C. filiformis* and *C. glabella*, but in *C. pubescens* the pollen grains are about 60 μm diameter.

Ehrendorfer et al. (1968, p. 344) gave for Lauraceae the uniform chromosome number of "x2 = 12", with detailed numbers for some "Lauroideae" but no account for "Cassythoideae". I found (with P.M.C. squashes in aceto-carmin) in each tetrad of *C. pubescens* the chromosome number to be $n = 24$, which is in agreement with the formula presented by Ehrendorfer earlier. (See Fig. 3).

Staminodes: The stamens of the fourth whorl are always sterile, having one vascular bundle, lacking cells and being pyramidal or cordiform. The third whorl of stamens (often in *C. filiformis*) or the second (antipetalous) whorl (in *C. racemosa*) are strap-like, if they lack cells. If the reduction is less complete, one locule still being present, they accordingly bulge asymmetrically.



Fig. 3. Chromosomes of *Cassytha pubescens* (Weber 6247, AD). Pollen Mother Cell squash at second metaphase. Photomicrograph (left), camera lucida drawing (right).

Glands: A pair of glands is associated with the stamens of the third whorl. Each gland is furnished with a vascular bundle which is derived from the inner large bundle divided into three in a radial arrangement (Sastri, 1952, p. 243). According to Kostermans (1957, p. 15), anatomical evidence shows that the glands which are widespread in the Lauraceae are not reduced staminodes, as had been suggested previously, and they contain "Oil cells and a rudimentary vascular bundle". In *Cassytha* they are shortly attached to the filaments and they completely fill the space between the filaments. However, Kostermans did not say what he believed the origin of the glands to be.

Ovary: Although the ovary is one-celled, with only one ovule, there is evidence that it is composed of three carpels, a condition termed pseudo-monomerous (Kostermans, 1957, p. 16). The stigma of *Cassytha* is sometimes slightly three-lobed, although this may be caused by compression in the bud by the three petals. The ovary is superior in the flower, showing during fruit development the transitional stages to perigyny. Formation of the ovary, as Sastri (1962, p. 198) described, is similar to that described for *Cinnamomum* (Sastri, 1958).

Ovule: The ovule is pendulous, anatropous, crassinucellate and bitegmic (Sastri, 1962, p. 198). The primordium becomes bent at the megaspore-mother-cell stage and finally the micropyle faces the style. The primary archesporium is multicellular and numerous megaspore-mother-cells are formed; as many as six embryo sacs may develop simultaneously in a single ovule; finally one to four of them protrude beyond the nucellus and enter the funiculus. The inner integument is two cells thick in *C. filiformis* and *C. pubescens*; in *C. glabella* it is thicker. The outer integument is four or five cell layers thick. After fertilization, the inner integument gradually disintegrates but the outer integument increases in thickness. Cells of the outer epidermis of the ovary become filled with tannin and form an outer fleshy zone; the cells of the inner epidermis acquire band-shaped helical thickenings and form a wall of a stony layer in the fruit.

Fruits

The fruit is mostly globular and is covered by the persistent calyx, which structure is called a "flower tube" by Kostermans (1957, p. 17) but which I term a "receptacular tube", although studies have not been conducted to establish with certainty whether this tube is derived from the receptacle or perianth. This is in agreement with Chakravarty (1969, p. 752) but Rendle (1963, p. 136) referred to it as a perianth-tube. Meisner (1864) called it a cup. It is at first very short, fleshy, (ob) conical and smooth. After pollination it enlarges more quickly than the ovary. During maturation the fruit is almost completely enclosed in the accrescent receptacular tube, which later becomes succulent underneath, the pericarp remaining dry, firstly green, later becoming dark-brown to black. Chakravarty (l.c.) considered that during the short course of fruit development, *Cassytha* shows a series from complete epigyny in the flower through perigyny to hypogyny when in fruit. As the receptacular tube is not fused with the fruit wall, it is considered preferable to refer to it rather as perigynous. The outer perianth segments are inserted on the rim, where the receptacular tube gradually merges with the base of the fleshy petals. In fruit the floral bracts are variously attached to or free from the lower part of the tube. In species with sessile flowers the floral bracts are verticillate at the base, touching each other laterally (see Fig. 2, G1, 3 & 6). In pedicellate flowers several arrangements occur. Only in some forms of *C. pomiformis* and *C. racemosa* the pedicel remains distinct in fruit, in all other species it becomes fleshy and incorporated into the false fruit together with the receptacular tissue. In forms of *C. pomiformis* which retain their pedicel in fruit, the bracteoles may be borne at either end of the pedicel. In the forms of *C. racemosa* which retain their pedicel the bracteoles are on opposite sides of the base of the false fruit. In all other forms of these species and all other species the bracteoles occur on the lower part of the false fruit (see Fig. 2, G2, 4 & 7), the space separating them from the axillant bract indicating the

contribution of the pedicel to the false fruit.

Endosperm: Endosperm is of the cellular type and in the mature seed is consumed by the growing embryo (Sastri, 1957, p. 240).

Embryo: Fertilization is essentially porogamous in *C. filiformis* (Sastri, 1962). After fertilization, the first division of the zygote is transverse. The mature embryo has a differentiated procambium and massive cotyledons, enclosing the plumule and leaf primordia, as in other autotrophic members of Lauraceae. "After discussing the bearing of embryological data" (Sastri, 1963, p. 428), "There is no justification for removing *Cassytha* from Lauraceae into a separate unigeneric family as suggested by Lindley (1853) and certain authors (Sastri, 1962)".

Cotyledons: The cotyledons are well developed, composed of two large, plano-convex halves, more or less fused, white and containing fatty oil, carbohydrates and proteins (Kostermans, 1957, p. 19). In *C. melantha* I was quite successful in separating them in the mature stage and exposing the embryo with its attachments to the cotyledons, but in other species cotyledons were consolidated and indistinguishable in the ripe seed. This problem was mentioned by R. Brown and others and discussed more fully by Bentham (1870, p. 308), who was informed by Dr Thwaites that "it is only at an early stage that the cotyledons are developed distinct in *C. filiformis*".

Biology

Dispersal of the seeds: The chief method of reproduction seems to be seed, which is abundantly produced each season. The false fruit is one-seeded, fleshy, glossy and smooth, green, sometimes red or yellow, with a taste usually bitter (somewhat similar to a *Pinus* leaf) and aromatic. It is apparently dispersed by birds, probably also by possums, which are attracted by the glossy "berries". The coat of bony exocarp presumably protects the embryo when swallowed.

Germination: According to Ewart (1919, pp. 370-371) and Kostermans (1957, p. 246), seed germinates best in almost pure sand and occurs in (spring) September and October. The hypocotyl escapes and forms a simple root. Side roots soon develop, furnished with root hairs and replacing the main root; the roots not having a root-cap. The food is rapidly absorbed from the cotyledons and remains dissolved in the cell-sap as sugar. The hypocotyl attenuates rapidly into a filamentous green axis and carries up the epicotyl within the fruit wall. The cryptocotylar mode of germination is regarded as advanced according to Sporne (1969). When the endosperm has been absorbed, the empty seed coat falls off. The first scale leaves are borne 5-9 cm from the ground. The seedling shows active clockwise circumnutation. After good parasitic attachment has been established, the basal part of the seedling shrivels and dies.

To promote germination under artificial conditions it is necessary to file the bony fruit wall. Sporadic bush fires in nature may facilitate germination by burning the fruit wall and also encourage the growth of lower shrubs and bushes needed by *Cassytha* as hosts after germination. In nature the fruit wall may also be damaged by digestive processes if swallowed by animals, or by decay.

Selection of the host: Generally the selection of the host by *Cassytha* is not very specific, but preferences may be noticed in some species, for example, rejection of some euphorbiaceous species in Australia. The most robust representative, *C. melantha*, is commonest on *Eucalyptus* spp., and flourishes well above the ground; *C. glabella* has been seen creeping on the ground, twining over grasses, as well as over a range of bushes. *C. aurea* and *C. peninsularis* occur on coastal dunes, growing on grasses and low matted bushes, but also further inland on shrubs (*Melaleuca* spp.) and low trees. I have observed *Cassytha* on aliens such as *Lycium ferocissimum* and *Pinus radiata*. *C. filiformis*

(Schroeder, 1978) has a large range of hosts, including *Persea americana* (avocado), a member of the same family, Lauraceae.

Annual growth: In *Cassytha*, annual growth as well as flowering and fruiting depend primarily on the rainfall, but weather conditions only indirectly affect the *Cassytha* plant through its host. Apparently, vegetative growth is diminished at flowering and fruiting. In favourable conditions *Cassytha* forms large tangled masses, often hanging 1-2 m from the hosts covering bushes in a thick layer, both hosts and parasite dying out gradually in the lower layers. It has been observed that fewer flowers are produced by heavily infested host plants. Ultimately the host may die, resulting also in the death of the parasite.

Pollination: I have not observed any particular insects on the flowers as possible pollinators, nor has any other information on pollination been found in the literature. The presence of the glands in the flower, and the quite long flowering period of several weeks may suggest insect pollination or wind pollination; on the other hand the introrse stamens and the small flowers may achieve self pollination.

Distribution

The great diversity of *Cassytha* species in Western Australia is evident from Table 1. In that State the genus is represented by ten of the fourteen Australian species and three varieties and six forms. Of these, five species, two varieties and four forms are endemic to Western Australia.

Other States all have far fewer taxa; Queensland being the richest of these.

Table 1. Occurrence of *Cassytha* species by State, with indication on non-Australian distribution.

| <i>Cassytha</i> | W.A. | N.T. | Qld | N.S.W. | Vic. | Tas. | S.A. | Other |
|--------------------------|------|------|-----|--------|------|------|------|---|
| 1. <i>aurea</i> | | | | | | | | |
| var. <i>aurea</i> | + | • | • | • | • | • | • | |
| var. <i>candida</i> | + | + | • | • | • | • | • | |
| var. <i>hirta</i> | + | • | • | • | • | • | • | |
| 2. <i>capillaris</i> | + | + | + | • | • | • | • | Malaysia and New Guinea pantropic |
| 3. <i>filiformis</i> | + | + | + | + | • | • | • | |
| 4. <i>flava</i> | + | • | • | • | • | • | • | |
| 5. <i>glabella</i> | | | | | | | | |
| f. <i>glabella</i> | + | • | + | + | + | + | • | |
| f. <i>bicallosa</i> | + | • | • | • | • | • | • | |
| f. <i>casuarinae</i> | + | • | • | • | • | • | • | |
| f. <i>dispar</i> | + | • | • | + | + | + | + | |
| 6. <i>melantha</i> | + | • | • | + | + | + | + | |
| 7. <i>micrantha</i> | + | • | • | • | • | • | • | |
| 8. <i>nodiflora</i> | + | • | • | • | • | • | • | |
| 9. <i>pedicellosa</i> | • | • | • | • | • | + | • | |
| 10. <i>peninsularis</i> | | | | | | | | |
| var. <i>peninsularis</i> | • | • | • | • | • | • | + | |
| var. <i>flindersii</i> | • | • | • | • | • | • | + | |
| 11. <i>pomiformis</i> | + | • | • | • | • | • | • | |
| 12. <i>pubescens</i> | • | • | + | + | + | + | + | New Zealand |
| 13. <i>racemosa</i> | | | | | | | | |
| f. <i>racemosa</i> | + | • | • | • | • | • | • | |
| f. <i>muelleri</i> | • | • | + | • | • | • | • | |
| f. <i>pilosa</i> | + | • | • | • | • | • | • | |
| 14. <i>rufa</i> | • | • | + | • | • | • | • | |
| Total taxa | 16 | 3 | 6 | 5 | 4 | 5 | 5 | |
| Total spp. | 10 | 3 | 6 | 5 | 4 | 4 | 4 | |

Map 1 shows the distribution of *Cassytha filiformis* (circles) in Australia and of all other species (solid spots). The absence of the genus from the Eremaean Zone is conspicuous.

Origins

Sastri (1952, p. 240) and Hutchinson (1969, p. 140) thought that the family Lauraceae was derived from the Magnoliales by reduction. *Cassytha* shows close similarities with most other genera of the Lauraceae in the attributes: trimerous flowers; two perianth whorls with slight differentiation; several staminodal whorls—usually four in Lauraceae—with one or two whorls in *Cassytha*; dehiscence of anthers by flaps; single carpel with one pendulous ovule; similarities in the vascular supply of various organs. However, the main differences occur in the structure of the stem and leaves. All other members of the Lauraceae are woody shrubs or trees with well-developed short- or long-petiolate leaves, while *Cassytha* has parasitic filiform stems with a specially developed vascular system for the transport of food in both directions and vestigial leaves.

Any discussion of the origin of *Cassytha* or its further dispersal is speculative. So far, no fossil record of *Cassytha* has been found in Australia, which is where it is now most widespread, nor am I aware of any record in other continents. There are no obvious links between *Cassytha* and the other members of the Lauraceae from which I believe it evolved, nor are there any morphological characters of definite value in determining the primitive or advanced status of any *Cassytha* species.

A knowledge of the present distribution of the genus may be helpful. *Cassytha filiformis* is spread mainly through the tropics of America, Asia, and Australia. No other species has yet been described from America. A second species occurs in Asia as well as in Australia, and a further three species are endemic in Africa. In Australia there are 14 species, with the greatest number in south-western Western Australia, but an equally great morphological range occurs in the southern Dividing Range. At least two of the African endemics are more closely related to Australian species than to *C. filiformis*.

While it cannot be established when the genus originated, its great morphological deviation from a family usually considered to be amongst the most primitive suggests a great antiquity. The rather restricted distribution in America and Eurasia and the few taxa which exist elsewhere may also signify a long history.

One possibility which should be considered, in view of the occurrence of the genus in Africa, America, Australia, India and New Zealand, is that it first appeared in Gondwanaland before the separation of the southern continents. Other possibilities are that it arose in the old-world tropics or that it evolved in Australia either over a wide area or, perhaps, in one of the areas, particularly rich in modern *Cassytha* species, after the Gondwanaland split.

In my view the best hypothesis at this stage is that parasitism arose in the Lauraceae in Australia in, or after, the Eocene when Australia separated from the rest of Gondwanaland. Of existing species, *C. pubescens* represents in its variability a link between most other species in Australia and is still evolving, to the extent that some of the extreme forms, which were previously described as different species, have not completed speciation. From it the evolution of most species from *C. pubescens* appears to be a relatively simple possibility. The widespread *C. filiformis* and, to a lesser extent, *C. capillaris* also appear possibly to have arisen from this stock.

The most robust representative of the genus, *C. melantha* is widespread through southern Australia and retains a homogenous habit throughout, but the thinner and finer *C. glabella* inhabiting nearly the same area shows variation in its fruits in different regions. The similarities of these two species with *C. pubescens* are not as great as are those of other species, and their affinities are not clear.

Taxonomic Concepts

All characters used in delimiting taxa in this work are morphological and can be observed on herbarium material using a lens or light microscope. As far as possible, taxa are distinguished from one another on more than one diagnostic character. However, some weighting of characters has been employed, resulting in some taxa being distinguished on single characters with subsidiary characters showing incomplete correlation. One exception is in distinguishing *C. pubescens* from *C. rufa*. Here it was found necessary, because of the complexity of the former, to employ combinations of both indumentum and fruit characters to identify it. Varieties and forms are also characterised entirely on morphological characters, the number of characters and the weight allotted to each character being used to determine the level. Thus, for example, *C. pubescens* and *C. aurea* are distinguished on flower size which correlates with geographical distribution and on a combination of other characters. *Caurea* var. *aurea* is distinguished from var. *hirta* on the basis of indumentum density and the degree of congestion of the flowers in the spike, both being considered insufficient to warrant species status. The four forms of *C. glabella* are distinguished only by the different shapes of the fruit. Similar criteria are applied in *C. racemosa* f. *racemosa* and f. *pilosa*, but f. *muelleri* is distinguished on the characters of the leaves and bracts being ovate-peltate or triangular-basifixed.

The morphological differences usually coincide with the geographical distribution of the taxa, but the distribution of the plants is, when used, always a secondary character in distinguishing taxa.

CASSYTHA L.

(Greek name *kasytas* or *kadytas* for *Cuscuta*, dodder.)

Cassytha (Osbeck. ined.) L., Sp. Pl. 35 (1753); Gen. Pl. 22 (1754); Nees, Syst. Laur. 642 (1836); Hook. f., Fl. Tasm. 1: 317 (1857); Meisner in DC., Prod. Syst. nat. Regni veg. 15: 252 (1864); Bentham, Fl. Austral. 5: 308 (1870); F.M. Bail., Queensland Fl. 4: 1313 (1901); Diels & Pritzel, Bot. Jahrb. Syst. 35: 201 (1905); Stapf in Theslton-Dyer, Fl. Cap. 1: 500 (1912); Allen, J. Arnold Arb. 23(2): 154 (1942); Kostermans in Humbert, Fl. Madagascar Fam. 81: 84 (1950); Kostermans, Reinwardtia 4(2): 193 (1957); Allan, Fl. New Zeal. 1: 137 (1961); Back. & Bakh. f., Fl. Java 1: 135 (1963); Hutchinson, Gen. Flowering Pl. 1: 143 (1964); Curtis, W.M. Stud. Fl. Tasm. 3: 596 (1967); Burbidge & Gray, Fl. A.C.T. 176 (1970); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, Handb. Pl. Vict. 2: 159 (1973); Chang, Fl. Taiwan 2: 409 (1976).

Holotype: *C. filiformis* L. (the only species recognised by Linnaeus, 1753).

Synonymy

For fuller synonymy and use of orthographic variants (*Cassyta*, *Cassitha* and *Cassita*) see Kostermans, Bibl. Laur. 215-219 (1964).

Rombut (Rumphius, Herb. Amb. 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750), nom. vern.); Adanson, Fam. Pl. 2: 284 (1763).

Holotype: *Cassytha filiformis* L. (no epithet has ever been combined with this generic name).

Volutella Forskal, Fl. Aeg.-Arab. 84 (1775).

Holotype: *V. aphylla* Forskal (= *C. filiformis* L.)

Calodium Loureiro, Fl. Cochinch. 247 (1790).

Holotype: *C. cochinchinense* Loureiro (= *Cassytha filiformis* L.).

Ozarthris Rafinesque, Fl. Tellur. 4: 92 (1836).

Syntypes: not lectotypified (*O. capense*, *O. opuntiioides*, *O. paradoxa*, *O. triquetra*).

Rumputris Rafinesque, Fl. Tellur. 4: 92 (1836).

Holotype: *R. fasciculata* (= *C. ?filiformis* L.).

Spiroonema Rafinesque, Fl. Tellur. 4: 92 (1836).

Holotype: *S. aphylla* ?(Forsk.) Rafinesque (= *C. filiformis* L.).

Pre-Linnean Synonyms

Acatsja-vali Rheede, Hort. Malab. 7: 83, t. 44 (1688).

Cuscuta-baccifera Plukenet, Almag. Bot. 3: 126, t. 172, f. 2 (1692).

Cuscuta altera Ray, Hist. Plant. 2: 1 (1704).

Cussuta Rumphius, Herb. Amb. 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Rombut putri Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Cuscuta-indica Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Cussutha Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Perennial parasitic, partly autotrophic twiners, containing abundant mucilage, attached by small elliptical haustoria formed along the stem at points of contact with the host. *Stem* filiform or terete, glabrous or pubescent, first green later in some yellow-green to brown-black, sometimes warted, on drying irregularly striate. Epidermal cells heavily cutinized, squarish in surface view, containing chlorophyll and reddish crystals. *Leaves* clasping, reduced to minute scales, spirally arranged on both stem and inflorescence in 1/3 phyllotaxis. *Inflorescence* erect, sessile or stalked, bracteate, a panicle, spike or raceme or reduced to a sessile or stalked head; axillant bracts present on peduncle and at each of its branches; whole deciduous after fruiting. *Flowers* bisexual, sessile or shortly pedicellate, ovoid or obovoid before opening; the bract and two smaller bracteoles verticillate or "split" if in two planes. Perianth and androecium confined to the rim of receptacular tube in trimerous whorls. *Perianth* segments 6, free, persistent obscurely nerved; sepals 3, scale-like, similar to floral bracts; petals 3, larger, fleshy, ovate, bluntly acute. *Receptacular tube* at first short, turbinate, shallowly concave in flower, tapering gradually downwards into the pedicel and continuing into petals upwards, after fertilization becoming fleshy and enlarging to enclose the ovary. *Stamens* 12 alternating in 4 whorls of 3; 3 (or 2) whorls fertile; 1 (or 2) represented by staminodes, usually white, drying brown. *Anthers* 2-celled, dehiscing from below by a distally-hinged flap (operculum). Stamens of the first whorl opposite sepals, always fertile, petaloid, by lateral expansion of filaments and connective, ovate to oblanceolate, cells terminal, introrse. Stamens of the second whorl opposite and shortly adherent to petals, fertile or sterile, fusiform; cells terminal, introrse. Stamens of the third whorl fertile or sterile, fusiform, resembling those of the first whorl, but slightly smaller, if fertile extrorse, with cells subterminal; with an ovoid gland on either side of the filament base often tipped with a white glandular appendage. Stamens of the fourth whorl sterile, opposite the stamens of the second whorl, shortly stipitate, fleshy, laterally compressed-ovoid, acute, cordate or pyramidal, about half the size of fertile stamens, sometimes tipped with glandular appendage similar to gland's tip which remains white on drying. Pollen acolpate. *Carpel* apparently solitary, erect, white, drying brown; ovary globular, unilocular with one pendulous anatropous ovule; style short, capitate stigma drying darker than ovary, persisting in fruit but not protruding beyond receptacle. After fertilization ovary forming crustaceous pericarp (bony putamen) which is enclosed by the fleshy receptacular tube. *Fruit* globular, bearing on top the lignified perianth and androecium sometimes encircled by glandular ring. *Pericarp* consisting of an inner canescent layer, a bony layer c. 0.5 mm thick and a thin rugose dark brown layer, surmounted by the base of the style expanded into a darker fringed cap. Seeds exendospermic; cotyledons thick, hemispherical, fleshy, yellowish, distinct only in the early stage, in central portion connected to embryo; radicle vertical.

Of 17 species at present recognised in the world, one species (*C. filiformis*) is cosmopolitan mainly in the tropics, but never very far inland; three species are endemic to

Africa; fourteen species occur in Australia, ten are endemic, one shared with Malaysia, two with New Guinea and one with New Zealand.

Key to *Cassytha* species and varieties in Australia

1. Plant glabrous; cilia and fimbriae absent from bracts and sepals 2
Plant pubescent and/or bracts and sepals ciliate or fimbriate 4
2. Flowers and fruits pedicellate (Tas.) 3. *C. pedicellosa*
Flowers and fruits sessile 3
3. Flowers less than 0.8 mm long; spirally arranged in spike (W.A.) 2. *C. micrantha*
Flowers over 1.3 mm long; distally crowded in head 1. *C. glabella*
4. Flowers and fruits subsessile; pedicel none or minute and concealed by the whorl of floral bracts 5
Pedicels at least 0.3 mm long, conspicuous; insertion of bracteoles remote from bract (except occasionally in *C. pomiformis*) 16
5. Flowers and fruits in sessile glomerules or heads 6
Flowers and fruits in elevated heads or spikes 7
6. Petals and fruits glabrous (W.A.) 9. *C. nodiflora*
Petals and fruits pubescent 6. *C. pubescens*
7. Petals glabrous 8
Petals pubescent 9
8. Fruit glabrous, globular, greenish (drying black); peduncle c. 0.5 mm thick 7. *C. filiformis*
Fruit strigose, ovoid, reddish (never drying black); peduncles 0.3-0.4 mm thick (dried) (W.A., N.T., Qld) 4. *C. capillaris*
9. Flowers in heads 10
Flowers in panicles or spikes 14
10. Peduncles less than 0.5 mm thick; flowers globular; floral bracts equalling flowers, conspicuous in flower-head (W.A.) 5. *C. flava*
Peduncles more than 1 mm thick (dried); flowers ovoid; floral bracts smaller than flowers, not protruding from flower-head 11
11. Stamines and basal glands with white glandular appendage (W.A.) 10a. *C. aurea* var. *aurea*
Stamines and basal glands without apical white glandular appendage 12
12. Fruit glabrous; stamens of the first whorl at least twice as long as broad (W.A., N.T.) 10b. *C. aurea* var. *candida*
Fruit pubescent (sometimes sparsely so); stamens of the first whorl c. 1½ times as long as broad 13
13. Bracteoles on peduncle remote from bract; stamines and glands dark tipped (W.A.) 10c. *C. aurea* var. *hirta*
Bract and bracteoles verticillate; staminodia uniform coloured 6. *C. pubescens*
14. Pubescence on petals short, black, retrorse; fruit glabrous, smooth, green (drying black) 12. *C. melantha*
Pubescence on petals white and red, not retrorse; fruit pubescent, smooth or papillose (drying variously) 15
15. Fruit papillose, ribs and glandular ring absent, drying brown (Qld) 11. *C. rufa*
Fruit smooth, sometimes with raised ribs or/and with glandular ring, drying grey-black. 6. *C. pubescens*
16. Fertile stamens 6 (second whorl opposite petals sterile, lacking cells) 14. *C. racemosa*
Fertile stamens 9 17
17. Flowers in (elevated) umbels; peduncle at fruiting clavate (W.A.) 13. *C. pomiformis*
Flowers in loose or congested heads (not umbels) or racemes 18
18. Flowers in loose heads or racemes; petals pubescent, green-grey (dried) (Qld, N.S.W., Vic.) 6. *C. pubescens*
Flowers in congested heads: petals glabrescent, yellow (dried) (S.A.) 19
19. Stamines and glands with white glandular appendage; ovary with ring of hairs medially; fruit streaked with alternate bands of white and red hairs, drying brown 8a. *C. peninsularis* var. *peninsularis*
Stamines and glands without glandular appendage; ovary glabrous; fruit glabrescent not streaked, drying black 8b. *C. peninsularis* var. *flindersii*

1. *Cassytha glabella* R. Br., Prod. Fl. Nov. Holl. 404 (1810), pro parte, as to the lectotype only; Sprengel, Syst. Veg. 2: 271 (1825); Nees, Syst. Laur. 645 (1836); Hook. f., Fl. Tasm. 1: 318 (1857); Meisn. in DC., Prod. 15: 254 (1864); F. Muell., Pl. Indig. Vict., -t. 68 (1864-1865); F. Muell., Fragm. Phyt. Austral. 5: 167 (1866); Benth., Fl. Austral. 5: 309 (1870); Schomburgk, Fl. South Australia 55 (1875); Spicer, Handb. Pl. Tasmania 130 (1878); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); Tate, Trans. R. Soc. S. Aust. 6: 149 (1883); F. Muell., Key Syst. Vict. Pl. 6, f. 5 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-1888); F. Muell., Native Pl. Vict. 1: 23, f. 4 (1889); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Tate, Census Indig. Flower. Pl. Extra-trop. South Australia 70 (1889); Tate, Handb. Fl. Extra-trop. South Australia 205 (1890); Bailey, Cat. ind. natur. Pl. Queensland 39 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Diels & Pritzel, Bot. Jahrb. Syst. 35: 201 (1905); Dixon, Pl. New South Wales 33 (1906); Bailey, Compr. Cat. Queensland Pl. 437, f. 422 (1913); Maiden & Betche, Census New South Wales Pl. 82 (1916); J.M. Black, Fl. South Australia 239 (1924); Domin, Biblioth. Bot. Band 22, Heft 89(2): 679 (1925); Ewart, Handb. Forest Trees Victoria 124 (1925); Ewart, Fl. Victoria 522 (1931); Gardner, Enum. Plant. Austral. Occ. 44 (1931); J.M. Black, Fl. South Australia 2(2): 365 (1948); Blackall & Grievé, How to Know Western Austral. Wildflowers 1: 169 (1954); Beadle, Evans & Carolin, Handb. Sydney Distr. 133 (1963); Curtis, Stud. Fl. Tasm. 3: 597 (1967); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, Handb. Pl. Victoria 2: 159 (1973).

Type: R. Brown s.n. (Bennett 3018), King George's Sound (Western Australia), Dec. 1801 (BM, lecto.). Two specimens in BM were identified by Brown as *C. glabella*. One, with the locality King George's Sound, conforms with the type description. The other without locality, is pubescent, does not therefore agree with the type description and is identified by the present author as *C. flava*. No other duplicates have been located and the former is selected as the lectotype.

The following binomials cannot be placed in their appropriate forma due to lack of fruits.

C. micrantha Meisn. in DC., Prod. 15: 256 (1864): pro parte, excl. lectotype, quoad spec.:

Type: J. Drummond 152, "Swan River", (Western Australia), (K, NY, syn.); *J. Drummond suppl. 61*, "Swan River", (Western Australia), a. 1845 (K, MEL 58498, syn.).

C. microcephala Meisn. in DC., Prod. 15: 253 (1864): pro parte quoad spec.:

Type: J. Drummond 68, "Swan River", (Western Australia), (K, MEL 58373, syn.); *R.C. Gunn 19*, Phillip Island, (Tasmania), (K, syn.).

C. filiformis Thunb. (non L.), Prod. Pl. Cap. 78 (1794), nom. illeg., was placed by Nees (1836, p. 446) under synonymy of *C. glabella*. The present author is of the opinion that the latter does not occur outside of Australia and that *C. filiformis* sensu Thunb., which was based on material from Africa, is not synonymous with *C. glabella*.

Vernacular names

"Smooth *Cassytha*", Bailey, Queensland Fl. 1314 (1901); "*Tangled Dodder-Laurel*", Ewart, Handb. Forest Trees Vict. 124 (1925); "*Slender or Tangled Dodder-laurel*", Willis, Handb. Pl. Vict. 2: 159 (1973); "*Slender Devil's Twine*", Ingram, C.K., Coll. No. 296.126.

Stem (0.2-) 0.4-0.6 (-1) mm thick, glabrous, green or yellow to red-green, smooth, drying yellow-brown. Young shoots glabrous; *leaves* triangular or triangular-ovate, obtuse, 0.4-0.5 x c. 0.3 mm, basifixed, glabrous, yellow-green, drying brown. *Haustoria* oval, commonly less than 1 mm long. *Inflorescence* usually a single or rarely paired, elevated congested cluster or head, not umbellate; peduncles (4-) 7-8 (15) x c. 0.5 mm, usually narrower basally, glabrous, (2-) 4-6 (-10) flowered. Supporting bract triangular, 1-1.5 x 0.5-1 mm, basifixed, glabrous, yellow-green, fleshy to scarios, turning leathery and dark-brown; bracteoles similar or smaller, 0.5-1.5 mm long. *Flowers* sessile or rare

pedicellate, ovoid to obovoid, 1.3-2 (-3.2) x 1 (-2) mm, mostly white, rarely yellowish. Floral bracts verticillate (in one plane), spreading or erect, glabrous; bracts ovate, acute, 1-1.5 x 0.5-1 mm, basifixed, light-green to yellow-green tinted red with narrow scarious margin, bracteoles similar, smaller, c. 1 mm long. Receptacular tube short, green, glabrous. *Sepals* ovate, 0.5-1 x 0.4-0.8 mm, glabrous, yellow-green with white or yellow scarious margin. *Petals* ovate to oblong-ovate, 1-2 (-3) x 0.8-1 (-1.5) mm, glabrous or very rarely pubescent outside, inside glabrous or rarely pubescent, white, drying yellow-brown to reddish-brown, more or less ridged lengthwise. Fertile *stamens* 9, white, drying brown; stamens of the first whorl c. 1 (-2) x 0.5-0.7 mm, filament under cells expanded laterally, wider than cells; stamens of the second whorl oblanceolate, c. 1 (-2) x 0.3-0.5 mm, cells obcordate, wider than filament; stamens of the third whorl oblanceolate, c. 1 (-2) x 0.3-0.5 mm, cells obcordate, wider than filament, often bulging over staminodes and glands. *Staminodes* pyramidal to wedge-shaped, 0.7 (-1) x 0.2-0.3 mm, shortly stalked, white, turning brown; gland ovoid to obovoid, $\frac{3}{4}$ size of the staminodes, white, drying brown, sometimes reddish. *Ovary* fusiform, c. 0.8 (-1.5) x 0.3-0.5 mm, white, glabrous, drying brown. Receptacular tube inside glabrous. *Fruit* ovoid to fusiform, 4.4-11 x 2.3-3.5 mm, green to honey-green, drying green or honey-yellow to reddish, often having 6 prominent longitudinal veins or a glandular ring on top. *Stone* ovoid to narrow-ovoid, 2.5-4.6 x 1.5-2.5 mm, green-brown to dark-brown. (Figs 4-7).

Distribution (Map 2)

Endemic to Australia, occurring in all States except Northern Territory.

Flowering

Flowering throughout the year in Australia, but flowering season differs from State to State.

Note

Collections with flowers only from Queensland and South Australia are assumed to be f. *glabella* and f. *dispar* respectively as these are the only forms known to occur in these States.

Specimens examined—in flower only

WESTERN AUSTRALIA: *Cronin s.n.* (MEL 58713, MEL 58715). *Diels & Pritzel s.n.* (PERTH). *Drummond s.n.* (MEL 58368). *George 9253* (AD, PERTH). *Keighery 1573* (Kings Park, Perth); *1997* (Kings Park, Perth). *Kenneally 1091* (PERTH); *1242* (PERTH). *Muir s.n.* (MEL 58652). *Newbey 677* (PERTH). *Preiss 195* (G). *Royce 8437* (PERTH).

NEW SOUTH WALES: *Bernardi 12191* (G). *Blakely s.n.* (NSW 134981). *Caley s.n.* (BM). *Cheel s.n.* (NSW 134991). *Duryer 1088* (NSW). *Gilbert s.n.* (AD 966050478). *Ingram 2196* (NSW). *McGillivray 1561* (NSW). *Rodway 1047* (K, NSW); *s.n.* (NSW 134984). *White s.n.* (BRI 177484). Hawkesbury Agric. Coll., Richmond (NSW 134998).

VICTORIA: *Davis s.n.* (MEL 58382). *Gates s.n.* (MEL 58383). *Hart s.n.* (MEL 58374). *Johnson s.n.* (MEL 58446). *Meebold 2462* (M). *Morrison 22* (B, PRC); *s.n.* (B); *s.n.* (BRI 080420); *s.n.* (K). *Reader s.n.* (MEL 58387). *Walter 1721* (B); *s.n.* (MEL 58618). *Anon.*, nr St Kilda (NSW 134974).

TASMANIA: *Archer 529* (K, M). *Bowen s.n.* (MEL 58649). *Buiston s.n.* (MEL 58391). *Davis 7394* (NSW). *Gunn 7* (K). *Jackson 105* (HO). *Johnston 75* (MEL). *Maiden s.n.* (NSW 134979). *Rodway 7393* (NSW). *Anon* (?R.C. Gunn) *27* (HO); *212* (MEL 58412).

Key to forms

1. Petals pubescent inside; two callosities distally on petals, scarious margin of sepals and floral bracts usually yellow (dried) (W. A. forma) Id. f. *bicallosa*
 Petals glabrous inside; scarious margin of sepals and floral bracts white (dried) 2
2. Fruit with conspicuous glandular ring (yellow) on top (W.A. forma) 1c. f. *casuarinae*
 Fruit without glandular ring. 3
3. Fruit ovoid, floral bracts almost horizontal 1a. f. *glabella*
 Fruit pyriform to fusiform, base clasped by almost vertical floral bracts 1b. f. *dispar*

Except for f. *bicallosa*, the forms can only be distinguished in fruit. See Table 2 for a summary of fruit dimensions of each form. *C. glabella* forma *bicallosa*, which is not indentifiable primarily on fruit characters, is not included in this table.

Table 2. Fruit dimensions (mm) in forms of *C. glabella*.

| | | W.A. | S.A. | Vict. | N.S.W. | Qld |
|----------------------|--------|------|------|-------|--------|-----|
| f. <i>dispar</i> | length | | | | | |
| | aver. | 7.5 | 6.0 | 5.0 | 5.5 | — |
| | max. | 10.9 | 7.9 | 8.5 | 6.3 | — |
| width | aver. | 2.8 | 2.5 | 2.3 | 2.5 | — |
| | max. | 3.7 | 3.3 | 3.3 | 2.9 | — |
| f. <i>glabella</i> | length | | | | | |
| | aver. | 6.2 | — | 4.5 | 4.4 | 4.9 |
| | max. | 7 | — | 5.5 | 5.1 | 5.5 |
| width | aver. | 3.5 | — | 3.1 | 3.0 | 3.1 |
| | max. | 3.7 | — | 3.5 | 3.6 | 3.5 |
| f. <i>casuarinae</i> | length | | | | | |
| | aver. | 5.5 | — | — | — | — |
| | max. | 7.7 | — | — | — | — |
| width | aver. | 3 | — | — | — | — |
| | max. | 3.5 | — | — | — | — |

1a. *Cassytha glabella* forma *glabella*

Flowers ovoid, 1.3-2.5 mm long; *sepals* and floral bracts with scarious always white margins. Fruit ovoid to globular, (4-) 4.5-5 (-5.5) x (2.7-) 3 (-3.7) mm (dried), green or yellowish to orange-red, drying green, smooth. Longitudinal veins hardly visible. Fruit sessile on the floral bracts, which spread more or less horizontally. Stone deep green-brown, ovoid, 3-3.5 x c. 2.5 mm. (Fig. 4.)

Distribution (Map 2)

Occurs as the only form of *C. glabella* in Queensland, dominant in New South Wales, common in eastern Victoria and occurs in Tasmania. In W. Australia is known from few localities.

Flowering

Flowers from Feb.-July in Queensland, from June-Oct. in Victoria; throughout the year in Tasmania; fruit maturation takes 2-3 months.

Notes

Collections from Queensland in flower are all believed to belong to forma *glabella*, as this is the only form known to occur there. However, in the absence of fruits from some specimens, their identification is not possible.

Specimens examined

WESTERN AUSTRALIA: *Broadbent* 149 (BM). *Chinnock* 3206 (AD, CANB, NSW, PERTH). *Eichler* 21112 (AD, PERTH). *Hnatiuk* 761273 (PERTH).

QUEENSLAND: *Coveny* 2000 (BRI). *Dowling* 4 (BRI). *Eames s.n.* (BRI 177486). *Gittins* 899 (BRI). *Harold* C075 (BRI). *Henderson* 592 (BRI, MEL); 931 (BRI). *Hubbard* 3937 (BRI, K). *Hunt s.n.* (K). *Nash* 24 (AD). *Simmonds* 427 (BRI). *Specht* 1448 (AD). *White s.n.* (BRI 177485); 7645 (BRI, NY). *Field Nats* (BRI 177491). *Anon*, Sunnybank (BRI 177487).

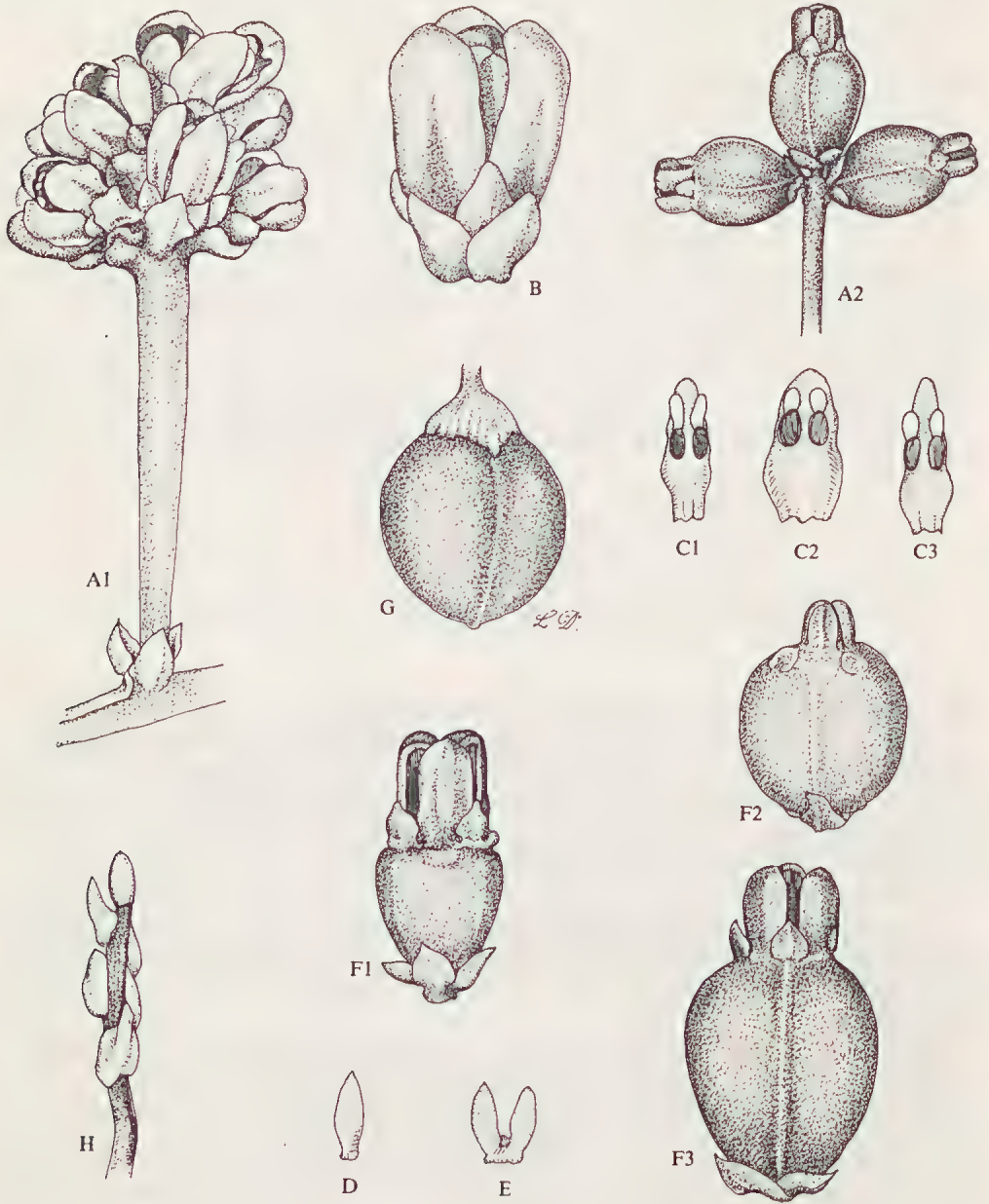


Fig. 4. *Cassytha glabella* f. *glabella*. A, inflorescence: A1, with flowers; A2, with fruits. B, flower and bracts. C, stamens, front view showing open loculi and upright flaps: C1, second whorl; C2, first whorl showing filament widened laterally; C3, third whorl. D, staminode. E, glands with base attached to receptacle. F, fruits: F1, young with almost horizontal verticillate bracts; F2, globose, showing bract and leathery perianth closing orifice; F3, obovate, showing almost horizontal verticillate bracts and perianth incompletely closing orifice. G, stone. H, young shoot with scale leaves.

NEW SOUTH WALES: *Blakely s.n.* (NSW 134993, 134994). *Boorman s.n.* (PR). *Camfield s.n.* (NSW 134980); *s.n.*, (G, NSW 134996, PERTH). *Carolin 3741, 3748, 8001* (SYD). *Cheel s.n.* (NSW 134998). *Coveny 1868, 4953* (NSW); *s.n.* (NSW 134985, 134986, 134998). *Evans s.n.* (CANB 3774, SYD). *Ford s.n.* (NSW 134992). *Fraser s.n.* (NSW 134987). *Gulliver s.n.* (MEL 58370). *Hamilton s.n.* (NSW 134995). *Ingram 3442* (NSW); *s.n.* (NSW). *Johnson 251* (NSW). *Lightgow 127* (NSW). *McGillivray 2039A* (NSW). *McKee s.n.* (SYD). *Rodway 7399* (K, NSW). *Salasoo 3741* (NSW). *Souer s.n.* (MEL 58381). *Wilcox s.n.* (MEL 58737). *Wilson 545* (NSW).

VICTORIA: *Aston 4, 6* (MEL). *Beauglehole 31205, 31279, 31519, 31570, 31676, 32637, 33037, 33486, 33963* (AD, BEAUGLEHOLE). *Cullimore 62* (MEL). *Hart 10* (MEL); *s.n.* (MEL 58442). *Morrison 1550* (K); *s.n.* (BM). *Pitcher s.n.* (MEL 58376).

TASMANIA: *Bufton 24* (MEL). *Davis 1264* (MEL). *Stuart s.n.* (MEL 50408). *Anon (?R.C. Gunn) 56* (MEL 58409, 58410).

AUSTRALIA: *L'hotsky s.n.* (OXF). *Verreaux s.n.* (OXF, NY). *Anon*, Nov. Holl. (PRC).

1b. ***Cassytha glabella* forma *dispar*** (Schltdl.) J.Z. Weber, stat & comb. nov.

C. dispar Schltdl., *Linnaea* 20: 578 (1847).

Type: *H. Behr 45*, An sandigen Orten, Sud-Australien, a. 1847, (HAL 42852, holo.).

C. micrantha Meisn. in DC., *Prod.* 15: 256 (1864), pro parte, excl. lectotype, quoad spec. *J. Drummond 149*, "Swan River", (Western Australia), (K, syntype).

Flowers ovoid or obovoid 1.3-2.5 mm long; *sepals* and floral bracts with scarious always white margins. *Fruit* fusiform to narrow-ovoid, (5-) 6-7 (-10.9) x (1.5-) 2.5 (-3.7) mm, pale-green or yellow to orange-red, dried young fruit very dark, mature golden to honey-yellow with lighter coloured, quite prominent longitudinal veins continuing into the perianth segments; basal portion narrowed to a stalk clasped by the almost vertical floral bracts. *Stone* green-brown to dark-brown, narrowly ovoid, 2.6-4.6 x 1.5-2.5 mm, at least 1/3 longer than wide. (Fig. 5.)

Distribution (Map 2)

Common in southern Western Australia, rare in New South Wales (Two Fold Bay), frequent in Victoria and Tasmania; in South Australia the only form known to occur.

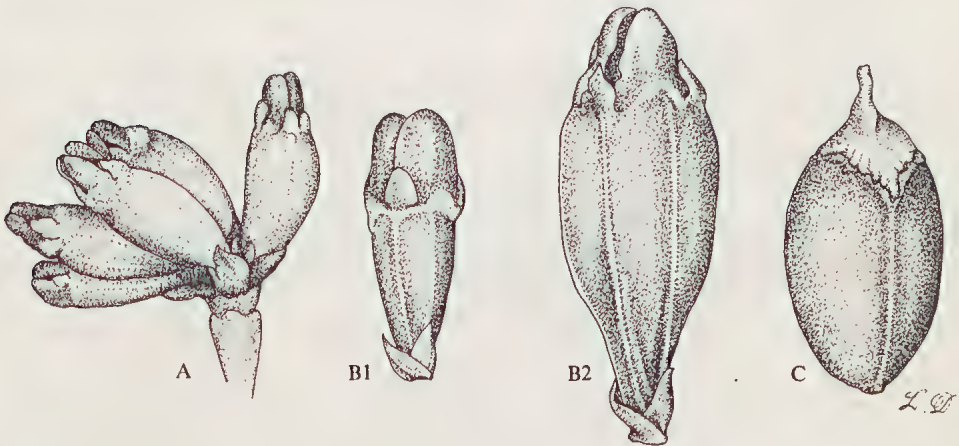


Fig. 5. *Cassytha glabella* f. *dispar*. A, fruits in head on tip of peduncle. B, fruits showing verticillate and almost vertical bracts and perianth: B1, young fruit; B2, mature fruit, showing faint vertical ribs (dried). C, stone with basal portion of style.

Similarities

Differs from *f. glabella* in the narrower and longer fruit, of which the basal portion of the receptacle rapidly expands at an early stage, elevating the perianth on a pedicel-like structure, which becomes wrinkled in the dried state, and in the floral bracts which clasp the stalk-like extension of the fruit and are almost vertical. Some collections from scattered places in South Australia have an almost globose fruit, but always elevated by a stalk above the floral rosette.

Specimens examined

WESTERN AUSTRALIA: *Aplin* 1926 (PERTH). *Batt s.n.* (MEL 58428). *Beaglehole* 12121 (BEAUGLEHOLE); 49200, 49293 (AD, BEAUGLEHOLE). *Chinnock* 3265 (A, AD, PERTH). *Cleland s.n.* (AD 97807196). *Eichler* 15855 (AD, G, PERTH); 19982, 20157 (AD, PERTH); 21139 (AD, NY, PERTH). *Fitzgerald s.n.* (NSW 135109). *Gardner* 726, 1668 (PERTH). *George* 10015 (PERTH). *Green* 455 (PERTH). *Haegi* 952 (AD, Z). *Helms s.n.* (AD 96633217, 97424459, MEL 58429, CANB, NSW 134977). *Hnatiuk* 760588 (PERTH). *Jackson* 1305 (AD, OXF, PERTH). *Keighery* 140 (PERTH); 1172, 1608 (KINGS PARK); 1593 (PERTH, KINGS PARK). *Kenneally* 1267 (PERTH); 1284 (AD, PERTH). *Koch* 2574 (BRI); 2349 (NSW); 3029 (MEL, NSW, PERTH). *Kuchel* 1600 (AD). *McFarland* 1258 (AD, PERTH). *Meebold* 10074 (M). *Merrall s.n.* (MEL 58664). *Morrison* 8432 (K); *s.n.* (BRI 158237). *Mueller s.n.* (MEL 58438). *Orchard* 1613 (AD, PERTH). *Paust* 599, 601, 974, 1075 (PERTH). *Pulley* 1372 (CANB). *Royce* 1265, 8092, 8983 (PERTH). *Salasoo* 353 (NSW). *Short* 639 (AD, MEL). *Smith s.n.* (K). *Story s.n.* (MEL 58654). *Waye s.n.* (MEL 58434). *Weber* 5228 (AD, BM, K). *Whibley* 5358 (AD, PERTH). *Wilson* 3242 (AD, MEL, PERTH); 8054 (AD, PERTH); 10085 (PERTH). *Anon*, Darkin (MEL 58416).

NEW SOUTH WALES: *Beaglehole* 33677 (AD, BEAUGLEHOLE, NSW). *Boorman s.n.* (G). *Morrison s.n.* (G). *Mueller s.n.* (MEL 58433, 58437).

VICTORIA: *Adamson s.n.* (K). *Aston* 613, 985, 1033 (MEL). *Beaglehole* 25214, 30814, 32225, 33500, 34150 (AD, BEAUGLEHOLE). *Bissil* 1 (MEL). *Carrick* 3319 (AD, CANB, MEL). *C.N. (?Nees) s.n.* (MEL 58378). *Davies* 120 (AD). *French s.n.* (MEL 58630). *Hart* 3, 5 (MEL); *s.n.* (MEL 58397, 58398, 58444). *Harvey* 7 (TCD). *Luehman s.n.* (BRI 176708, MEL 58731). *Morrison* 1552 (K); 1553, 1557 (BM, K); 1559 (PERTH); 1560 (BRI, MEL); 1561 (NSW); 1562 (CANB); 2068 (AD, K, M, MEL); 2071 (AD, NSW); 2072 (NSW, PERTH); 3049 (MEL); 5073 (CANB, PERTH); *s.n.* (BM, CANB 50232, G, M, MEL 58392, NSW 134976, PERTH). *Mueller s.n.* (K, MEL 58379, 58385). *Reader* 23, 26 (MEL); *s.n.* (MEL 58386, 58388, 58389). *Spence s.n.* (MEL 58686). *Studer s.n.* (G). *Sullivan* 8a (MEL). *Walter s.n.* (MEL 58621, NSW). *Weber* 3720 (AD, P). *Whibley* 3372 (AD). *Williamson s.n.* (MEL 58337, NSW 134972). *Anon*, St Kilda & East Brighton (NSW 135129); Robertson (K); nr Stawell (MEL 58626).

TASMANIA: *Archer s.n.* (K). *Atkinson* 123 (HO). *Barker* 902 (AD). *Buften* 11 (MEL). *Caley s.n.* (BM). *Chinnock* 2253 (AD, HO). *Comber* 1388, 2339 (K). *Gunn* 27 (BM, K, NSW, HO); *s.n.* (TCD). *Hooker s.n.* (MEL 58421, NY). *Milligan s.n.* (BM). *Rodway s.n.* (HO 7457, 7461). *Sharman s.n.* (HO 7459). *Somerville s.n.* (HO 7455, 7465). *Anon* 605 (MEL 58411).

SOUTH AUSTRALIA: *Alcock* 2909, 4607 (AD). *Ashby* 697 (AD). *Babbage s.n.* (MEL 58436). *Barker* 1798 (AD, BRI, OSH, TRN, WU). *Bates s.n.* (AD 97615025, 97623147, 9772580). *Beek* 110 (AD); 141 (AD, G, H). *Blaylock* 432, 1656 (AD). *Black s.n.* (AD 97424473-7). *Booth* 9 (AD, K, L, M, UC, W). *Browne s.n.* (MEL 58623, 58625). *Carrick* 3495 (AD, K, TCD). *Carrodus s.n.* (AD 96212146). *Chigwidden s.n.* (ADW 42360). *Cleland s.n.* (AD 96609621, 97307150, 97424461). *Cooper s.n.* (AD 96228338). *Copley* 2563, 4338 (AD). *Crocker s.n.* (ADW 4596). *Dodson* 102 (AD). *Donner* 228 (AD, BRI); 1176, 5515 (AD); 4752 (AD, K). *Eardley* 5001 (ADW); *s.n.* (ADW 1094, 6091). *Eichler* 12147 (AD, NY); 12173 (AD, L); 14254 (AD, CHR, MEL); 14515 (AD); 16301 (AD, CANB); 18512 (AD, UC). *Fieldhouse* 47 (AD). *Grivell* 4 (AD); *s.n.* (AD 96927291). *Haegi* 324, 427 (AD). *Heddle* KCP58 (AD). *Hubbard* 8561 (K). *Hunt* 519 (AD). *Husseys s.n.* (MEL 58431, 62375). *Ising s.n.* (AD 96219255, 96321063, 966021428, 966021433, 966021445, 966021447, 966071504, 97006138). *E. Jackson* 7, 1638 (AD). *I. Jackson* 515, 562, 965, 974, 980, 1007, 1017 (AD). *Kuchel* 1247, 2276, 2710 (AD). *Lea s.n.* (K, partly). *Lothian* 1245 (AD). *Maiden s.n.* (NSW 134978). *Menzel s.n.* (AD 97424456-7). *Mueller s.n.* (MEL 58417-8, 58424). *Nash s.n.* (AD 97027076, 9734004). *Orchard* 151a (AD). *Purdie* 179a (AD). *Rendle s.n.* (K, partly). *Salasoo* 1667 (NSW). *Salisbury s.n.* (OXF). *Sealy s.n.* (MEL 58413). *Sexton s.n.* (AD 96924049). *Shaw s.n.* (AD 97244291). *Souhcott s.n.* (AD 97330110). *Specht* 31 (AD); *s.n.* (AD 96109495). *Spooner* 365, 811, 910, 4159, 4491 (AD). *Symon* 1609, 6407, 8551 (ADW). *Tate s.n.* (AD 97424455, 97424463). *Tepper s.n.* (MEL 58629-30). *Weber* 643, 1795, 1866, 2020, 3709, 3809, 3830, 4032, 4158, 4284, 4408, 4412, 4458, 5232 (AD). *West* 2237, 2418 (AD). *Wheeler* 340 (AD). *Whibley* 40, 1393, 1476, 1575, 2246 (AD). *White s.n.* (AD 97617077, 97601978). *Wilkinson s.n.* (ADW 18351). *Wilson* 1233 (AD); 1301 (AD, MEL, PERTH); 1431 (AD, HO); 1929 (AD, CANB, NT); 2808 (AD, LY). *Anon*, Mt Compass (AD 966070668); Onkarparinga (MEL 58419); Pt Lincoln (MEL 58415).

AUSTRALIA: *Mueller s.n.* (MEL 58426, NY).

1c. *Cassytha glabella* forma *casuarinae* (Nees) J.Z. Weber, stat & comb. nov.

C. casuarinae Nees in Lehmann, Pl. Preiss. 619 (1845); Meisn. in DC., Prod. 15: 253 (1864).

Type: *J. Drummond 64*, Western Australia (MEL 58369 neo., K, NY, iso.).

C. digitata Nees in Lehmann, Pl. Preiss. 620 (1845); Meisn. in DC., Prod. 15: 257 (1864).

Type: *L. Preiss 1626*, Princess Royal Harbour, (Western Australia), Dec. 1840, (MEL 58579, syn.).

C. microcephala Meisn. in DC., Prod. 15: 253 (1864), *pro parte* quoad spec.: *W.H. Harvey 4*, King George's Sound, (Western Australia), Jan., Febr. 1854 (NY, TCD syntype); *W.H. Harvey 8*, King George's Sound, (Western Australia), Jan., Febr. 1854 (NY, TCD syntype).

C. racemosa non Nees, sensu Benth., Fl. Austral. 5: 312 (1870), p.p. as to syn. *C. digitata* Nees.

Flowers ovoid 1.3-2.5 mm long, *sepals* with white scarious margins turning yellow and gland-like in fruit later. *Fruit* turbinate to campanulate, (4.5-) 5-5.5 (-7.7) x (2.5-) 3 (-3.5) mm, (?green), drying golden-brown finely dotted with glands; conspicuous yellow glandular ring in form of plate surmounting the fruit under perianth segments, drying yellow to brown; longitudinal veins hardly visible. *Fruit* sessile or stalked on floral rosette which clasps the base. *Stone* dark brown, ovoid and 2.5-3 x c. 2 mm, to globose and c. 2 mm in diameter. (Fig. 6.)

Distribution (Map 2)

Collections were made near the southern coast of Western Australia and Swan River.

Notes

The type specimen listed by Nees was *L. Preiss 1624*, York District, Western Australia, March, 1840, but this was probably destroyed in BONN or B and no duplicate has been located. The type description agrees with this form. Meisner (1864) cited, among others, *J. Drummond 64* and *L. Preiss 1624*. On the assumption that he had examined both and found them in close agreement, the Drummond specimen has been selected as a neotype.

Similarities

Differs from f. *glabella* and f. *dispar* in having a yellow glandular ring apparent from early stages of fruit development and in the sepals turning yellow.

Specimens examined

WESTERN AUSTRALIA: *Ashby 5332* (AD). *Davies 469* (AD). *Jackson s.n.* (CANB, NSW, PERTH). *Koch 2574* (MEL 58439-40). *Kenneally 1272* (AD, PERTH). *Meebold 11069* (M). *Morrison 7405* (K). *Mueller s.n.* (MEL 58637). *Pritzel 173*, (K, NSW). *Royce 4225, 4228* (PERTH). *Sewell s.n.* (MEL 58635, 58648). *Whibley 5413* (AD, PERTH). *Wilson 4362* (PERTH).

1d. *Cassytha glabella* forma *bicallosa* J.Z. Weber, forma nov.

Caulis c. 0.6 mm crassus; pedunculus c. 10 mm longus; *flores* c. 6 in capitulo aggregati; floris bractee verticillatae, margine *sepalorum* flavo scarioso; *petala* obovata, 2-3 mm longa, distaliter bicallosa, callis ellipsoideis, c. 0.5 mm longus; *stamina* ordinis primis lata; *stamina* ordinis secundis et tertiis oblanceolata, similia; *staminodia* subulata, 0.4-0.5 mm longa; glandulae breviores.

Type: (? Anon. per) *A. Oldfield s.n.*, Oolingurru (Oolingurrah), (Murchison River, Western Australia), (MEL 58432, holo.; K, iso.).

Stem 0.5-0.7 mm thick, yellow-brown (in sicco). Peduncles to 10 mm long, c. 0.5 mm thick, narrower basally, mostly 6 flowered in a capitate cluster. Subtending bract triangular, 0.5-2 x c. 0.7 mm, acute, basifixed, glabrous, brown (in sicco); bracteoles similar, smaller. *Flower* obovoid, (1.9-) 2.4-3 (-3.2) x (1.2-) 1.4 (-1.6) mm. Floral bracts almost erect; bract c. 1.5 x c. 1 mm, scarious margin usually yellow; bracteoles similar, smaller. *Sepals* c. 1 mm long, usually with narrow scarious margin (in sicco); *petals* obovate, 1.5-3 x 0.6-1 mm, glabrous outside, white pubescent inside, indumentum short,

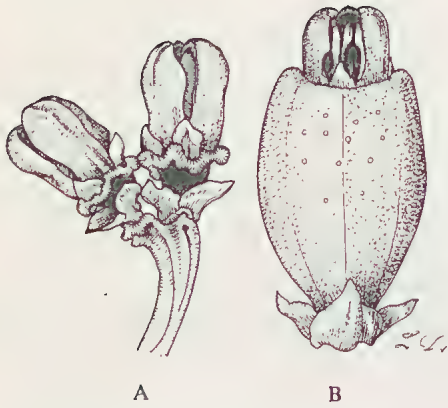


Fig. 6. *Cassytha glabella* f. *casuarinae*. A, young fruits on peduncle, showing stressed glandular ring (dried) at base of perianth. B, mature fruit showing verticillate bracts and the glandular ring at base of perianth.

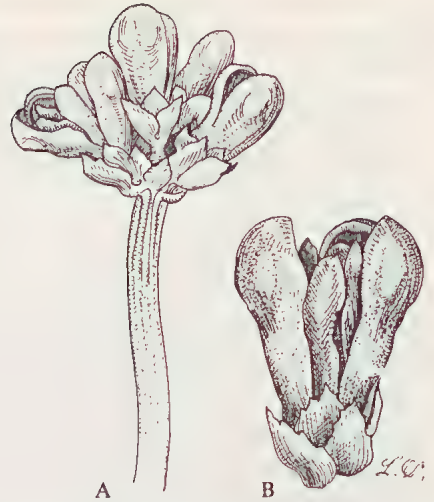


Fig. 7. *Cassytha glabella* f. *bicallosa*. A, flowers on the peduncle. B, flower showing verticillate bracts, stamens (in the middle) and callosities distally on the petals.

hairs several celled, slightly glandular; distally bearing two internal callosities 0.4-0.6 mm long, which may bulge on the outside, white, powdery-waxy inside. *Stamens* of the first whorl ovate, c. 2 x 0.5 mm, filament under cells wider than cells; stamens of the second whorl narrow-lanceolate, c. 2 x 0.3 mm, occasionally with hairs sprinkled dorsally; stamens of the third whorl narrow-lanceolate c. 1.8 x 0.3 mm. *Staminodes* subulate, 0.4-0.5 x c. 2 mm, glands similar, smaller for 1/3rd. *Receptacular tube* papillose pubescent inside. Fully developed *fruit* not seen. Young fruit spherical, apically with glandular ring. (Fig. 7.)

Distribution (Map 2)

Endemic to south-western Western Australia. Collections have been made near the mouth of the Murchison River, Claremont in the Lower Swan River, in the Swan District, Darling Range and Watheroo.

Similarities

Similarities with f. *glabella* in having a hemispherical sessile fruit, with f. *casuarinae* in having a yellow fleshy glandular ring but it differs from them in the petals being pubescent inside.

Specimens examined

WESTERN AUSTRALIA: *Cranfield* 1250 (PERTH). *Griffin* 1811 (PERTH). *Hnatiuk* 780058 (PERTH). *Keighery* 1997 (PERTH, KINGS PARK). *Pritzel* 173 (AD, BM, G, HBG).

2. *Cassytha micrantha* Meisn. in DC., *Prod. Syst. nat. Regni veg.* 15: 256 (1864).

Type: *W.H. Harvey* 1, King George's Sound, (Western Australia), Jan., Feb., 1854, (TCD, lecto.). (See notes.)

Stems glabrous golden-greenish (dried), (0.2-) 0.3-0.4 (-0.6) mm thick, haustoria 1-2 mm long, *leaves* narrow-ovate, c. 0.5 x 0.2 mm. *Inflorescence* usually a single stalked loose spike; *peduncle* (8-) 10-15 (-23) mm long, thickest in central portion, c. 0.5 mm thick, 10-15 flowered or more, supported by a narrow-lanceolate bract 0.5-1 mm long and two

similar bracteoles. *Flowers* globular, sessile, conspicuously spirally arranged in 1/3 phyllotaxis, sometimes 1 is remote below, may be aborted and then bracts present only. Floral bracts verticillate, conspicuous; bract triangular, acute, c. 0.7 x 0.3 mm, glabrous, honey coloured; bracteoles similar but narrower, c. 0.5 mm long. Basal flowers c. 0.7 mm, apical c. 0.4 mm, developing acropetally; *sepals* triangular-ovate, 0.3-0.4 x 0.2-0.3 mm long, honey coloured; *petals* ovate, mucronulate, incurved to hooded, to c. 0.6 mm long and wide, golden-brown (dried), darker than sepals. Fertile *stamens* 9, c. 0.5 mm long,

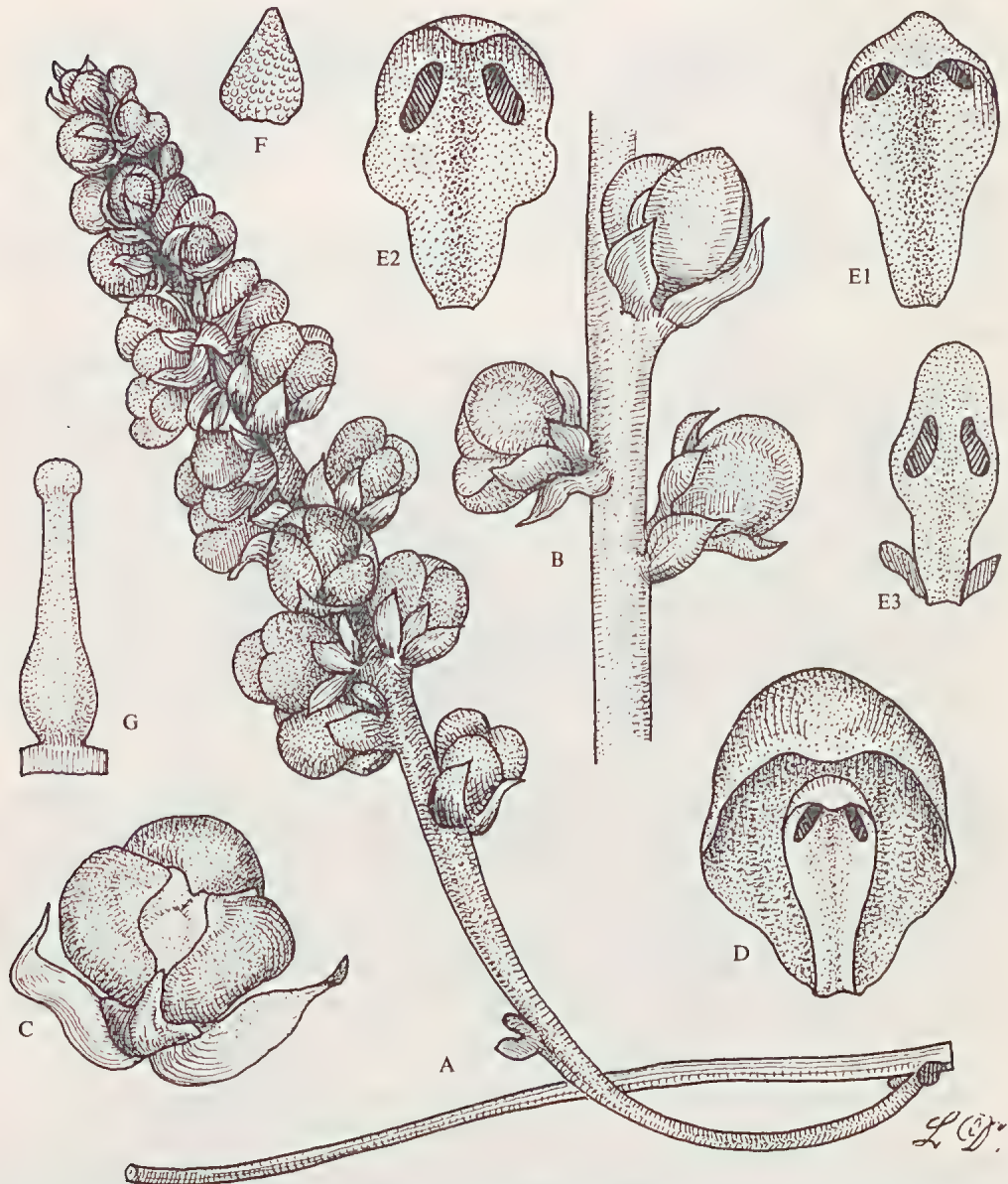


Fig. 8. *Cassytha micrantha*. A, stem and inflorescence in flower. B, flowers showing spiral arrangement in 1/3 phyllotaxy. C, flower with bracts. D, petal from inside, with dorsi-basally adnate stamen of the second whorl. E, stamens, front view showing loculi: E1, second whorl; E2, first whorl, showing laterally expanded filament; E3, third whorl, with two glands basally. F, staminode. G, ovary.

white, turning brown; stamens of the first whorl spatulate, 0.35-0.4 mm across, filament widened just below cells, narrowed at base; stamens of the second whorl oblong-spathulate, c. 0.3 mm across, cells wider than filament, tip blunt, inflexed; stamens of the third whorl fusiform, c. 0.25 mm across, cells wider than filament and placed centrally, tip obtuse, straight. *Staminodia* triangular-pyramidal, c. 0.2 x 0.1 mm, brown (dried); gland ovoid, c. 0.1 mm long, brown (dried). *Ovary* fusiform, c. 0.5 x 0.2 mm, honey-coloured (dried). Receptacular tube glabrous outside and inside. *Fruit* not seen. (Fig. 8.)

Distribution (Map 3)

Endemic to the southern coast of Western Australia where it is known from two collections, one east of Esperance, Thistle Cove (34° 01' S, 122° 12' E), *A.S. George s.n.*, 21.i.1966 (PERTH) and *W.H. Harvey 1*, type collection from King George's Sound.

Flowering

Flowers Jan.-Feb.

Similarities

Similar to *C. glabella*, but differs in the loosely spiral arranged spike and smaller globular flowers to 0.7 mm long, ripening acropetally. This is the most slender-stemmed representative of the genus.

Notes

In his description of *C. micrantha*, Meisner (1864) cited three Drummond collections and one of Harvey's, all from Western Australia. The only duplicates located are in K (*Drummond 61, 149, 152*), MEL (*Drummond 61*), NY (*Drummond 152*) and TCD (*Harvey 1*). *Drummond 149* is fertile and identifiable as *C. glabella* f. *dispar*. The other Drummond specimens are sterile but conspecific with his *149*. The Harvey specimen is fertile and of a different species. The Drummond specimens at Kew were identified in Meisner's hand as *C. micrantha* but his doubt of their identification is indicated on numbers *61* and *149* by a question mark. The Harvey specimen was not annotated by Meisner. Meisner distinguished between *C. glabella* and *C. micrantha*, as is evident by his placing them in section *Capitatae* and *Spicatae* respectively, largely on inflorescence characters. On these grounds the Harvey specimen, with a very distinct elongate spike, is selected as the lectotype rather than the sterile or capitata collections of Drummond.

3. *Cassyltha pedicellosa* J.Z. Weber, sp. nov.

Plant glabra; *caulis* tenuis, (0.3-) 0.4-0.5 (-0.7) mm crassus, ramosissimus, obsolete striatus; haustoria elliptica, vix 1 mm longa; *folia* squamiformia, ovata, c. 0.5 mm longa. Pedunculi solitarii, 8-20 mm longi, c. 0.4 mm crassi, 3-5 floribus (vel plus), suffulti bractea una et bracteolis binis. Floris bractee in planitiebus duobus, bractea basem pedicelli amplectens, bracteolae $\frac{3}{4}$ supra basem pedicelli amplectentes. *Flores* globosi, c. 1 mm in diametro, distincte pedicellati; *sepala* triangularia; *petala* ovata, subacuta, c. 0.9 x 0.8 mm. *Stamina* perfecta 9; *stamina* ordinis primi cordata, rostellata, introrsa; secundi ordinis obcordata, introrsa; *stamina* ordinis tertii obcordata, extrorsa; *staminodia* ovata, c. 0.1 mm longa, opposita *staminibus* ordinis primi; glandulae geminatae, quam *staminodia* breviora, *stamina* ordinis tertii amplectentes. *Ovarium* subglobosum; stylus subulatus; stigma parva, globosa. *Fructus* ovoideus, verrucis crassius superpositus, tubo receptaculo graduatim angustato in pedicellum. *Caryopsis* subrotunda, c. 2.5 x 2.3 mm.

? Type: *Rodway* (? *L.*), *s.n.* (1892), Derwent, Tasmania. (MEL 58390, holo.).

Plant glabrous; *stem* (0.3-) 0.4-0.5 (-0.7) mm thick, (golden-reddish to brown in sicco); haustoria elliptical, under 1 mm long; *leaves* ovate, c. 0.5 mm long. *Inflorescence* single; flowers in a stalked loose cluster, supported by a triangular, acute bract and two bracteoles, c. 1 x 0.7 mm. Peduncle 8-20 mm long, c. 0.4 mm thick, 3-5 (? more) flowered. Floral bracts in two planes; bract ovate to triangular, subacute, c. 0.8 x 0.5 mm basally clasping the pedicel; bracteoles remote, triangular, subacute c. 0.4 x 0.3 mm, clasping the pedicel in the upper 2/3rd. *Flowers* globular, c. 1 x 1 mm, on a 1 mm or slightly longer

pedicel, c. 0.3 mm thick, becoming thicker to 0.5 mm in fruit; receptacular tube fusiform, gradually narrowing into pedicel; *sepals* triangular, subacute, c. 0.7 x 0.6 mm; *petals* ovate, subacute, c. 0.9 x 0.8 mm, slightly hooded, golden-brown (dried). Fertile *stamens* 9; stamens of the first whorl obcordate, c. 0.8 x 0.4 mm, filament not expanded into vellum; stamens of the second whorl cordate, slightly beaked, c. 0.7 x 0.4 mm; stamens of the third whorl obcordate, c. 0.6 x 0.4 mm; staminodes ovoid, c. 0.1 mm long, glands $\frac{3}{4}$ of size of staminode. *Ovary* c. 0.9 x 0.3 mm (dried). Receptacular tube glabrous

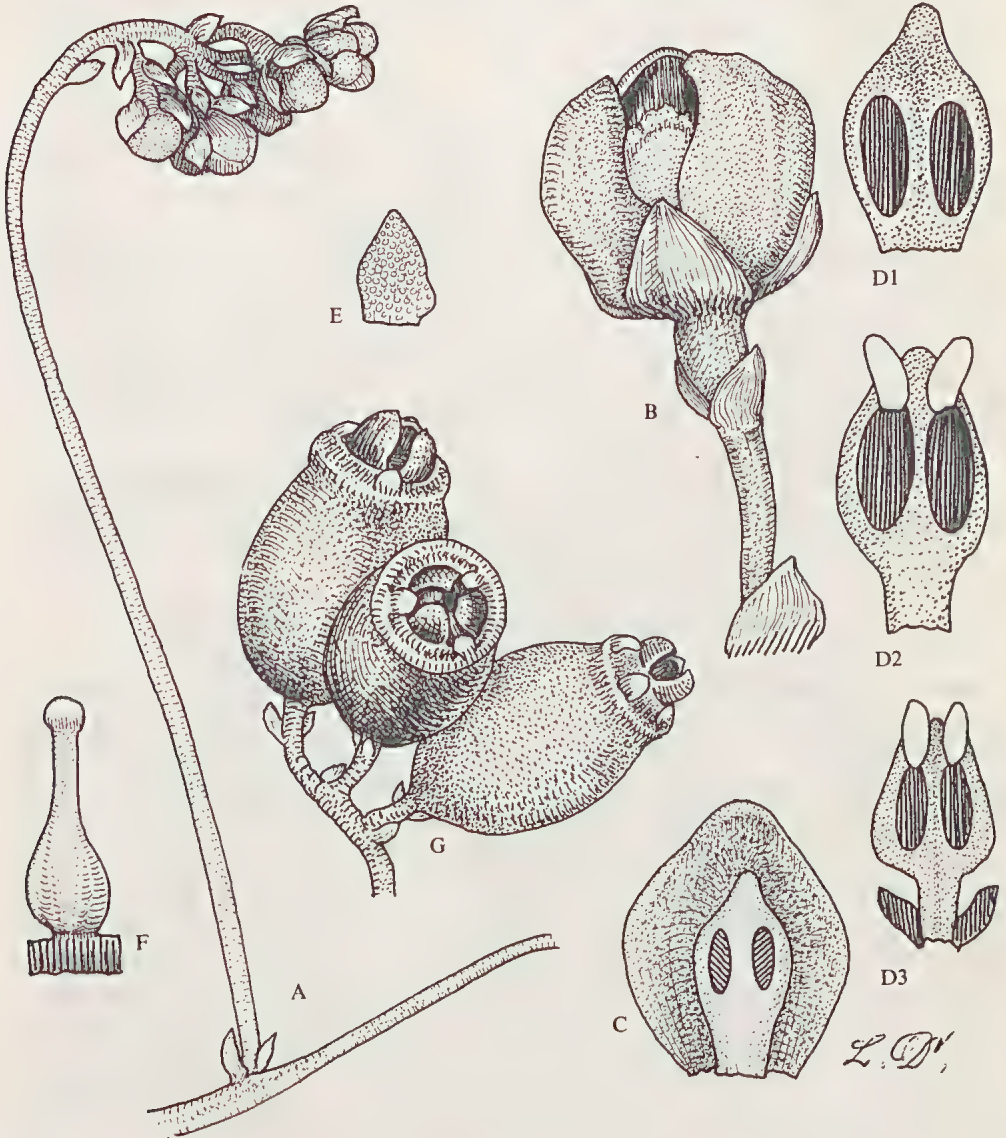


Fig. 9. *Cassytha pedicellosa*. A, stem and inflorescence in flower. B, flower, showing pedicel with basal bract and remote higher bracteoles flanking pedicel. C, petal, from inside with dorsi-basally attached stamen of the second whorl. D, stamens, front view showing loculi: D1, second whorl; D2, first whorl, showing upright flap; D3, third whorl, showing upright flap and two basal glands. E, staminode. F, ovary. G, fruits, showing pedicels attached to the peduncle and the glandular ring apically encircling the perianth.

inside. *Fruit* ovoid, glabrous, 4.2-4.5 x 2.5-3 mm, dark red-brown, longitudinally striate with darker lines, surmounted by conspicuous verrucae in the form of a thick plate (black dried); sphaeroid portion is carried on extended receptacular tube, which gradually attenuates into pedicel clasped by two bracteoles. *Stone* ovoid, dark-brown, c. 2.5 x 2.3 mm. (Fig. 9.)

Distribution (Map 4)

Endemic to Tasmania, known from a single collection made by Rodway from the Derwent (? River).

Flowering

The single collection is lacking the information on flowering.

Similarities

Differs from *C. glabella* in the conspicuous pedicel, floral bracts in two planes and dark brown fruit; from *C. micrantha* in the flowers clustered in a loose head.

Notes

It is the only glabrous Tasmanian species with pedicellate flowers and glandular ring on the fruit.

4. *Cassytha capillaris* Meisn. in DC., Prod. 15: 252 (1864); Hooker, Fl. Brit. India 5: 188 (1885); Pax in Engler & Prantl. Natürl. Pflanzenfam. 3(2): 124 (1891); Trimen, Handb. Fl. Ceylon 3: 455 (1895); Booberg, Bot. Jahrb. Syst. 66(1): 8 (1933); Allen, Journ. Arn. Arb. 23: 155 (1942).

Type: *J. Motley 539*, Bungarmassing, Borneo, 1857-8 (Herb. Hooker) (K, holo.).

C. glabella non R. Br. sensu Ewart & Davies, Fl. Northern Territory 113 (1917) quoad spec.: *R. Brown* (Bennett 3018), Islands of the Gulf of Carpentaria, a, b, c, e, f, g₁, g₂, g₃ (Sweers Island [islanda]), Nov.-Dec. 1802 (K-2 sheets); *F. Mueller*, Sturt's Creek, Jan.-May, 1856 (K).

C. strigosa Fitzg., Journ. R. Soc. W. Aust. 3: 143 (1918); Gardner, Enum. Pl. Austral. Occ. 44 (1931).

Type: *W.V. Fitzgerald 817*, Base of Mt Broome, Western Australia, May, 1905 (NSW, holo.).

C. tenuis Allen, Journ. Arn. Arb. 23: 155 (1942).

Type: *L.J. Brass 6514*, Mabaduan, Western Division, Papua, Apr. 1936 (A, holo., n.v., BRI 009564, iso.).

Stem (0.2-) 0.4-0.5 (-1.4) mm thick, drying green to reddish brown, young shoots glabrous or red pubescent, becoming glabrescent. *Haustoria* elliptic, mostly under 1 mm long. *Leaves* fleshy, ovate to triangular, c. 1 x 0.5 mm, glabrous or puberulent, commonly red ciliate. *Inflorescence* single, rarely paired spike; peduncles 2-18 x 0.3-0.5 mm, glabrous or with thick short strigose hairs or having long and dense retrorse or antrorse indumentum. Peduncles cylindrical or slightly clavate or attenuate when long, sometimes zig-zag, 3-10 flowered, flowers crowded distally or loose along peduncle. Supporting bract triangular to lanceolate, mostly ciliate, 0.5-1 mm long, usually less than 0.5 mm broad, bracteoles similar, narrower. *Flowers* sessile, globose, c. 1.2 mm across before expanding. Floral bracts verticillate; bract triangular, c. 1 x 1 mm, puberulent to glabrous, red ciliate; bracteoles similar, smaller. Receptacular tube pubescent or glabrous. *Sepals* triangular, c. 0.5 mm long and wide, mostly glabrous, red-ciliate. *Petals* ovate, bluntly acute, c. 1.1 x 1 mm, glabrous, greenish outside, whitish inside, sometimes slightly red tinted, some are bordered with a narrow dark rim (dried) which in fruit turns into a hyaline margin. Fertile *stamens* 9, white; stamens of the first whorl lanceolate to ovate, c. 0.7 x 0.3-0.6 mm, varying in the width of the filaments, which are narrower or wider than cells, sometimes laterally slightly pointed; stamens of the second whorl oblanceolate, c. 0.7 x 0.3 mm, upper portion inflexed, tip blunt; stamens of the third whorl obovate, c. 0.6 x 0.3 mm, cells obcordate, wider than filaments, tip blunt. *Staminodes* pyramidal, tip wedge shaped, c. 0.3 x 0.2 mm, white, occasionally with a

white apical gland; glands ovoid or obovoid, c. 0.2 x 0.15 mm, occasionally with a white apical gland. *Ovary* fusiform, glabrous, c. 0.9 x 0.4 mm (dried). Receptacular tube inside glabrous. *Fruit* ovoid, 4-6 x 3-4 mm (dried), glabrous or pubescent, hairs adherent, vinaceous red, drying darker. *Stone* ovoid, c. 3 x 2.5 mm, dark red-black. (Fig. 10.)

Distribution (Map 5)

Occurs in Borneo, Buru (Boero), Ceylon, New Guinea, ? Timor and in northern Australia north of 24° latitude: in Western Australia from North West Cape eastwards through the Kimberley region; in Northern Territory through Arnhem Land entering deeply southwards in the arid region; in Queensland occurring on the Barkly Tableland and Cape York Peninsula.

Flowering

Flowers apparently all year round, depending on rain.

Similarities

Distribution of *C. capillaris* overlaps with *C. filiformis* and resemblance is quite remarkable in specimens resembling types of *C. strigosa* and *C. tenuis* which have elongate peduncles and loosely arranged flowers. In both species the young shoots and inflorescence may be pubescent to some degree and the petals are always glabrous. In *C. filiformis* the receptacular tube is always glabrous, as are the fruits which are regularly globular, green and drying black, while the fruits in *C. capillaris* are smaller, ovate and

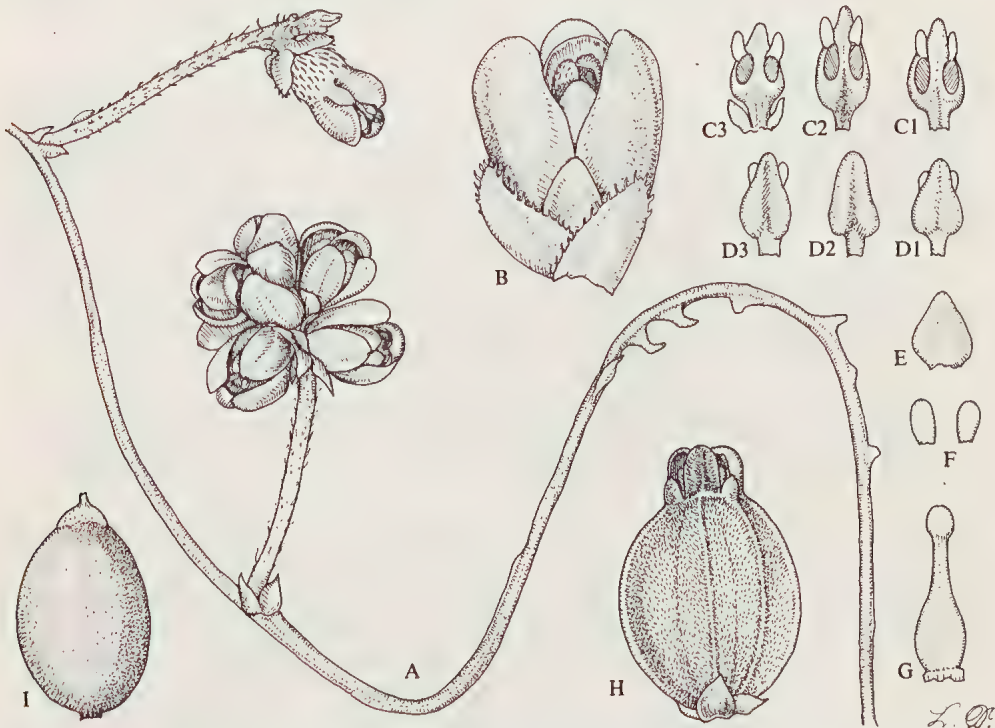


Fig. 10. *Cassytha capillaris*. A, habit drawing, stem with haustoria (which did not attach to the host) and two peduncles; upper peduncle with young fruit showing the strigose indumentum and lower peduncle with a head of flowers. B, flower with bracts. C, stamens in front view, showing open loculi and upright flaps: C1, first whorl; C2, second whorl; C3, third whorl with two basal glands. D, same stamens as in C, but in rear view. E, staminode. F, glands. G, ovary. H, mature fruit showing verticillate bracts basally, strigose hairs and perianth with closed orifice. I, stone.

red even when dry. The stem of *C. filiformis* is stouter and even in the least hairy forms scattered hairs are more frequent than in *C. capillaris*, which is almost glabrous, although glabrescent forms of *C. filiformis* occur in Queensland. Peduncles of *C. filiformis*, whether short or long, are never less than 0.5 mm thick, and those in *C. capillaris* are under 0.5 mm thick (dried). Petals of *C. filiformis* (dried) have a basal dark (blackish) triangle which continues on to receptacular tube, and is conspicuous in fruit, but has not been observed on *C. capillaris*. Some specimens have 5-10 flowers congested in a head on 5-10 mm long peduncles, resembling *C. glabella*, but the peduncle is irregularly covered with short and thick or long, soft scattered hairs, and the fruit is reddish and pubescent to glabrescent. Similarities with *C. ciliolata* show in the short peduncle and few flowers crowded distally, but these species differ in the petals which are pubescent in *C. ciliolata* and glabrous in *C. capillaris*.

Notes

The type specimen of *C. capillaris* has peduncles 7-8 mm long, slightly clavate (dried) and pubescent, with 6 or 7 flowers congested apically; the stamens are more or less subequal, the cells obcordate and wider than the filament, the fruits are ovate, dark red with scattered hairs. The type specimen of *C. strigosa* has peduncles 15-18 mm long, attenuate, with dense retrorse reddish indumentum, up to 10 loosely arranged flowers per spike, the filaments of the first staminal whorl expanded up to 0.5 mm and wider than the cells. The type of *C. tenuis* has shorter peduncles 5-10 mm long, attenuate with antrorse reddish indumentum, only three flowers arranged loosely in the head, and the filaments of the first whorl up to 0.3 mm broad and narrower than the cells. All types have similar fruits.

The five characters, on which the types of *C. capillaris*, *C. strigosa* and *C. tenuis* could be segregated, are not considered to provide a basis for recognizing three species. The form of inflorescence, occurring in the type of *C. strigosa*, is very unusual. The author has seen only one other collection, from Western Australia (*P.G. Wilson 11457*), which resembles the type in this character, but on the same specimen some peduncles are shorter with few (-3) flowers, more closely resembling the type of *C. tenuis*. The stamens of this specimen are, however, closer to those of the type of *C. strigosa* (c. 0.4 mm wide). The breadth of filaments of the first whorl varies from c. 0.3-0.5 mm wide in other collections from tropical Australia and the width, not correlated with any other character, does not appear to be taxonomically significant within the complex.

A second related New Guinea collection seen by the author *Robbins 2392*, Roma road, Middle Sepik Plains, 9.ix.1959 (CANB 71263), has peduncles 5-10 mm long, up to 3 flowers gathered distally and narrow filaments, differing from the type of *C. tenuis* in that the indumentum is retrorse.

Most collections whether from close to the type locality of *C. strigosa* and *C. tenuis* or distant from them, including one from the Moluccas, *Alston 17040*, Namlea (3° 30' S, 126° 30' E), 2.ix.1954 (CANB 149625), have shorter peduncles (5-10 mm long) glabrescent or with retrorse indumentum, few flowers (-3), and the filaments of the second whorl varying from narrow to wide, and the fruits varying from pubescent to glabrescent. Some of the collections are very like the type of *C. capillaris*.

The description of *C. capillaris* given here covers the great variation seen in Australian and New Guinea specimens, the author being unable to correlate with geographical distribution any of the morphological characters distinguishing the types of *C. capillaris*, *C. strigosa* and *C. tenuis*. He is of the opinion that both the types *C. strigosa* and *C. tenuis* represent extreme forms of this species, and the name *C. capillaris* Meisn. is correct.

Specimens examined

WESTERN AUSTRALIA: *Beaglehole* 46905, 47059, 47866, 48249, 48801, 48894 (BEAUGLEHOLE); 51542, 51646, 52274, 52429, 52588, 52967, 52998, 53065, 53219, 53252, 53435, 53467, 53685, 53848, 53958, 54198 (AD, BEAUGLEHOLE). *Chinnock* 3850 (AD). *Eichler* 22212 (AD, CANB). *Fitzgerald* 164, 239, 748 (PERTH). *George* 3271, 3391, 6584 (PERTH). *Keighery* 774 (KINGS PARK). *Royce* 7130, 7152 (PERTH). *Symon* 10082 (AD, ADW); 11457 (ADW). *Weber* 4858 (AD, CANB, PERTH). *Wilson* 11413, 11457 (PERTH).

NORTHERN TERRITORY: *Basedow* 142 (K). *Beaglehole* 10622 (BEAUGLEHOLE, NT); 46268 (BEAUGLEHOLE); 50569, 50647, 50684, 50701, 50753, 50847, 54410, 58724, 59732 (AD, BEAUGLEHOLE). *Brown* (*Bennett* 3018) (BM). *Chippendale* s.n. (AD 95952131, CANB 74502, MEL 58357, NSW, NT 4291). *Edward* s.n. (ADW 23305). *Henshall* 1903 (NT). *Latz* 205 (AD, MEL, NT). *Lazarides & Adams* 164 (CANB, NSW). *Martin* s.n. (NSW 135221). *Must* 365 (AD, MEL, NT). *Mueller* s.n. (K). *Symon* 7720 (ADW). *Schomburgk* 132 (K).

QUEENSLAND: *Brown* (*Bennett* 3018) (BM). *Everist* 3291 (BRI, CANB). *Lavery* 115 (BRI). *Persietz* 63 (MEL). *Smith* 129, 12526 (BRI).

BURU (BOUERO): *Alston* 17040 (CANB).

NEW GUINEA: *Robbins* 2392 (CANB).

SRI LANKA: *Ferguson* s.n. (MEL 62328).

5. *Cassytha flava* Nees in Lehmann, Pl. Preiss. 1: 620 (1845); Meisn. in DC., Prod. Syst. nat. Regni veg. 15: 255 (1864); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); F. Muell., Sec. Syst. Census Austral. Pl. 7 (1889); Gardner, Enum. Plant. Australe Occid. 44 (1931); Blackall & Grieve, How to know Western Australian Wildflowers I: 168 (1954).

Type: *L. Preiss* 1622, Fremantle, (Western Australia), Jan. 1839 (MEL 58361, lecto.; MEL 58362 & MEL 58363 iso-lecto.). (Lectotypified here.)

Stem filiform, (-0.2) 0.6 (-1.1) mm thick, grey-golden, diffuse-tomentose at first, becoming glabrescent later. Some hairs to 1 mm long, irregularly twisted and tinted red. *Haustoria* irregular in size and shape, sometimes stalked, more or less 1 mm across. *Scaly leaves* ovate, 0.5-1 x 0.3-0.6 mm fleshy, golden-brown (dried), retrorse-pubescent, hairs scattered. *Inflorescence* mostly solitary, rarely paired; bract narrowly lanceolate, leathery (dried), acute, 1-3 x c. 0.5 mm, covered with long scattered hairs, ciliate, glabrous beneath; bracteoles similar, smaller. *Peduncles* (3-) 12-18 (-32) x 0.2-0.5 mm narrower basally; long peduncles many-flowered, with long diffuse hairs; short peduncles few-flowered, with short retrorse hairs. *Flowers* 5-15, mostly in a head, sometimes one remote lower on the peduncle, subtended by verticillate floral bracts; bract ovate, acute, 1-1.5 x 0.5-0.8 mm, brown, leathery (dried), white-pubescent, ciliate, protruding among the flowers; bracteoles similar but about 1/3 as large. *Flowers* yellow, globular and c. 1 mm across before opening, rotate later, white-pubescent. *Sepals* when alive ovate, 0.5-1 mm x c. 0.5 mm, pubescent, yellow, glabrous inside, drying triangular, brown, c. 0.5 x 0.5 mm, thick-leathery. *Petals* ovate, subacute, 0.8-1.5 x 0.7-1 mm, pubescent outside, yellow, glabrous or slightly pubescent inside, remaining yellow when dried even on the fruit. *Receptacular tube* very short, yellow, pubescent. *Nine stamens* fertile, brown, triangular; stamens of the first whorl slightly wider, up to 0.6 mm, puberulent on the back; stamens of the second c. 0.7 x 0.5 mm, with thick short filaments sometimes pubescent on back; stamens of the third whorl ovate, 0.6 x 0.4 mm, reflexed, glabrous. *Staminodes* pyramidal, c. 0.3 x 0.3 mm, pubescent, tipped with oblique fleshy glabrous white glands which dry dark; glands ovoid, c. 0.2 x 0.15 mm, glabrous, not tipped with a gland. *Ovary* fusiform 1-1.5 x 0.5 mm, pubescent in upper half which protrudes from the pubescent receptacular tube. *Fruit* globular, grey, c. 4 mm across, densely white-pubescent; putamen globular, c. 3 mm across, black. (Fig. 11.)

Distribution (Map 6)

Endemic to Australia. Occurs in south-western Western Australia.

Flowering

Flowering probably all the year round, but fruits have only been collected from October to December.

Notes

The indumentum may vary from heavily villous to glabrescent; the indumentum is restricted to strigose hairs on top of the peduncle and the floral bracts and the sepals are only ciliate. Glabrescent forms may show similarities with *C. glabella*, but are easily distinguished by the rotate opened flowers, yellow triangular-ovate petals and brown stamens. Some flowers on a specimen from near Cape Riche (34° 36' S, 118° 47' E), (*W. H. Harvey* 7, March, 1854), have on the calyx tube a dense red pubescence forming a conspicuous rim round the base of the perianth.

Specimens examined

WESTERN AUSTRALIA: *Aplin D4/68* (PERTH). *Diels & Pritzel 228* (PERTH). *Drummond 62* (MEL; 67 (MEL, NY). *George 6084* (PERTH). *Goodall 537, 3961, 1877B* (PERTH). *Hamilton s.n.* (NSW 135121). *Harvey 7* (TCD). *Keighery 1533* (KINGS PARK). *Morrison 311* (PERTH); 10322 (BM, BRI, NSW); s.n. (BRI 158233, BM). *Mueller s.n.* (MEL 58751, 58754). *Orchard 1612* (AD, PERTH). *Preiss s.n.* (G). *Pritzel 186* (BM, G, NSW). *Royce 8096* (PERTH). *Wilson 3880* (PERTH).

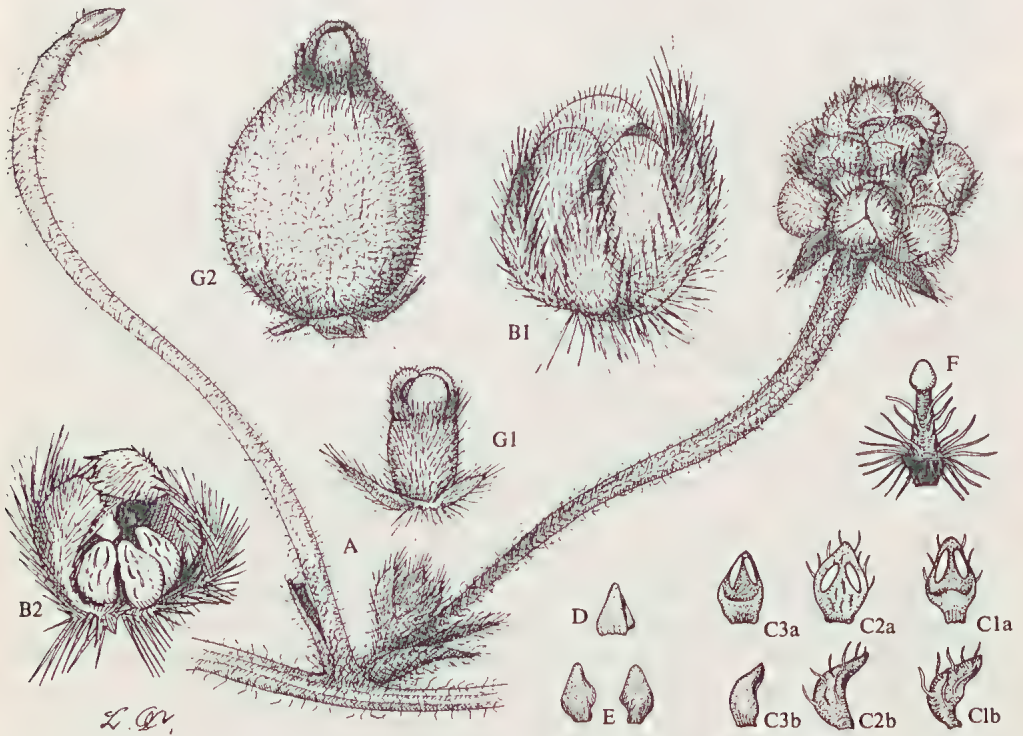


Fig. 11. *Cassytha flava*. A, stem with paired inflorescence, right peduncle with flowers. B, flowers: B1, with bracts; B2, with petals removed to show stamens. C, stamens (a, front view showing loculi; b, side view): C1, second whorl, showing hairs on the back; C2, first whorl, showing filament widened laterally and hairs on the back; C3, third whorl. D, staminode. E, glands. F, ovary and lower style, showing hairs. G, fruit: G1, young fruit with bracts; G2, mature fruit, showing verticillate bracts and perianth with closed orifice.

6. *Cassytha pubescens* R. Br., Prod. Fl. Nov. Holl. 404 (1810); Nees, Syst. Laur. 648 (1836); Meisn. in DC., Prod. 15: 255 (1864); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Benth., Fl. Aust. 5: 310 (1870); Schomburgk, Fl. South Australia 55 (1875); Spicer, Handb. Pl. Tasmania 130 (1878); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); Tate, Trans. R. Soc. S. Aust. 6: 149 (1883); F. Muell., Key Syst. Vict. Plant. 2: 6 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-1888); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Tate, Trans. R. Soc. S. Aust. 12: 62 & 70 (1889); Bailey, Cat. indig. natur. Pl. Queensland 39 (1890); Tate, Handb. Fl. South Australia Extratrop. 205 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Rodway, Tasmanian Fl. 165 (1903); Diels & Pritzel, Bot. Jahrb. Syst. 35: 202 (1905); Dixon, Pl. New South Wales 33 (1906); Bailey, Compr. Cat. Queensland Pl. 423 (1913); Maiden & Betche, Census New South Wales Pl. 82 (1916); Domin, Bibliot. Bot. Band 22, Heft 89(2): 680 (1925); Black, Fl. S. Aust. 1(2): 239 (1922); Hart, Victorian Naturalist 42: 79-83 (1925); Ewart, Pl. Victoria 523 (1931); Black, Fl. S. Aust. 2(2): 365 (1948); Beadle, Evans & Carolin, Handb. Sydney Distr. 133 (1963); Curtis, Stud. Fl. Tasmania 3: 597 (1967); Burbidge & Gray, Fl. A.C.T. 165 (1970); Beadle, Stud. Fl. North Eastern New South Wales 2: 119 (1972); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, A Handb. Pl. Victoria 2: 160 (1973).

For fuller bibliography of *C. pubescens* see Kostermans, Bibl. Laur. 234 & 235 (1964).

Type: R. Brown (Bennett 3021), Journey Australia, 1802-5, (most likely New South Wales or Victoria) (BM, lecto., K, iso.). *J. Banks & D. Solander*, Australia, eastern seaboard, 1770, (BM-2 sheets, NSW, syn.). (Lectotypified here.)

C. paniculata R. Br., Prod. Fl. Nov. Holl. 404 (1810); Sprengel, Syst. Veg. 2: 271 (1825); Nees, Syst. Laur. 647 (1836); Meisn. in DC., Prod. 15: 256 (1864); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Hooker, Handb. N.Z. Fl. 239 (1867); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); F. Muell. Sec. Syst. Census Austral. Pl. 7 (1889); Bailey, Cat. Indig. natur. Pl. Queensland 39 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Cheeseman, Man. New Zealand Fl. 604 (1906); Dixon, Pl. New South Wales 33 (1906); Maiden & Betche, Census New South Wales Pl. 82 (1916); Cheeseman, Man. New Zealand Fl. ed. 2: 461 (1925); Ewart, Handb. Forest Trees Victoria 125 (1925); Hart, Victorian Nat. 42: 79 & 83 (1925); Allan, Fl. New Zealand 1: 137 (1961); Beadle, Evans & Carolin, Handb. Sydney Dist. 133 (1962); Beadle, Stud. Fl. North Eastern New South Wales 2: 119 (1972); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972).

For fuller bibliography on *C. paniculata* see Kostermans, Bibl. Laur. 233 (1964).

Type: R. Brown, Port Jackson, Aug. 1803 (BM, syn.); *J. Banks & D. Solander*, eastern seaboard, 1770 (BM, syn.).

C. paniculata var. *phaeolasia* F. Muell., Frag. Phyt. Aust. 5: 167 (1866), basionym of *C. phaeolasia* (F. Muell.) Benth.

Type: F. Mueller, East boundary of Gipp's Land (MEL 58512, lecto.); *F. Mueller*, near Womboyn(e), Sept. 1860 (MEL 58510, MEL 58511, NSW 134542, syn.). (Lectotypified here.)

C. phaeolasia (F. Muell.) Benth., Fl. Aust. 5: 310 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); F. Muell., Key Syst. Vict. Pl. 2: 6 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-8); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Moore, Handb. Fl. New South Wales 19 (1893); Dixon, Pl. New South Wales 33 (1906); Maiden & Betche, Census New South Wales Pl. 82 (1916); Ewart, Handb. Forest Trees Victoria 124 (1925); Hart, Victorian Nat. 42: 79-83 (1925); Ewart, Fl. Victoria 522 (1931); Hart, Victorian Nat. 63: 12-13 (1946); Willis, Handb. Pl. Victoria 2: 160 (1973).

C. pubescens Schldtl., Linnaea 20(5): 577 (1847), nom. illeg.: Benth., Fl. Austral. 5: 310 (1870).

Type: H. Behr 44, Bethany, South Australia (HAL 42844, holo.).

C. piligera Schldtl., Linnaea 21: 446 (1848); Meisn. in DC., Prod. 15: 255 (1864); Benth., Fl. Austral. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901); Eichler, Suppl. J.M. Black's Fl. South Australia 150 (1965).

Type: H. Behr 44, as for *C. pubescens* Schldtl., (Schlechtendahl, l.c. renamed *C. pubescens* Schldtl., as it was homonymous with R. Brown's *C. pubescens*.)

C. pubescens var. *fasciculata* Meisn. in DC., Prod. 15: 255 (1864), based on type of *C. piligera* Schldtl.

C. pubescens var. *macrostachya* F. Muell., Fragm. 5: 167 (1866) nom. nud.; Hart, Victorian Naturalist 42: 79-81 (1925) (quoad spec. *F. Mueller s.n.*, between Port Fairy and Portland Way (MEL 58562), annotated by Mueller).

C. glabella Herb. Sieber n. 218 (BM, G-2 sheets, HAL 42845, K, P-2 sheets), Meisn. in DC., Prod. 15: 256 (1864), pro syn.

C. remotiflora F. Muell. ex Meisn. in DC., Prod. 15: 256 (1864), basionym for *Cpaniculata* var. *remotiflora* (F. Muell. ex Meisn.) Benth.

Type: F. Mueller, Moreton Island, Aug. 1855 (MEL 58504, lecto.; K-2 sheets, NY, iso.).

C. paniculata var. *remotiflora* (F. Muell. ex Meisn.) Benth., Fl. Aust. 5: 311 (1870); Bailey, Queensland Fl. 4: 1314 (1901); Bailey, Compr. Cat. Queensland Pl. 439 (1913).

C. rugulosa Meisn. in DC., Prod. 15: 255 (1864); Benth., Fl. Aust. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901).

Type: Fraser 77, N. Holland (K, lecto.; NY, iso.).

C. tasmanica Meisn. in DC., Prod. 15: 252 (1864); Benth., Fl. Aust. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901).

Type: R. C. Gunn 532, George Town, 23.x.1843 (K, lecto.; NY); R. C. Gunn 532, Kangaroo Bottom, 23.ix.1840 (K, syn.); R. C. Gunn 532, V.D. Land—Tasmania (K-? syn.).

C. tepperana Ludw. ex Tepper, Bot. Centralblatt 49(51): 5 (1888); Tate, Trans. R. Soc. S. Aust. 12: 62 (1889); Eichler, Suppl. J.M. Black's Fl. S. Aust. 150 (1965).

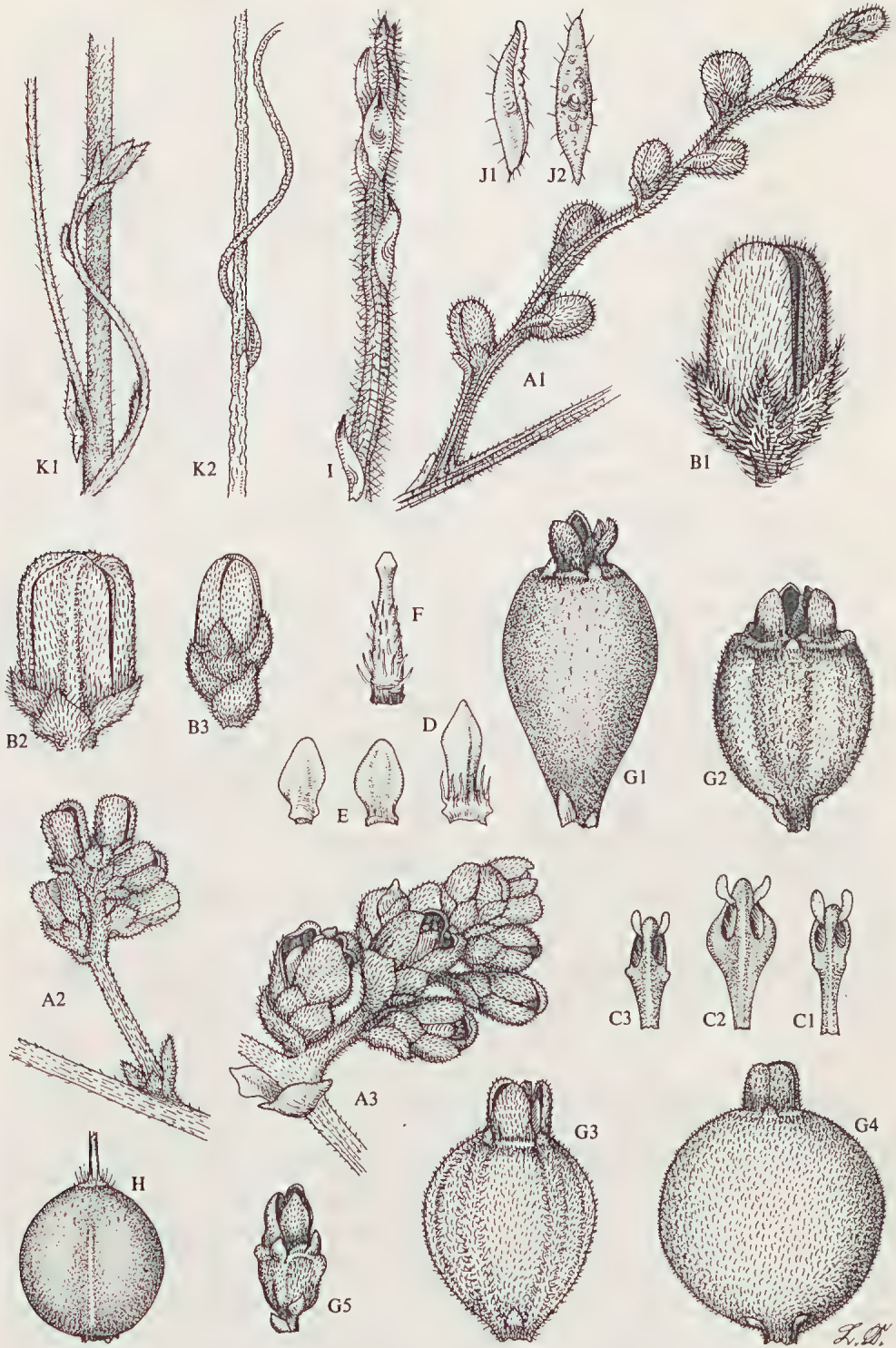
Type: J. G. O. Tepper: Karatta, 11.xi.1886 (MEL 58665, lecto.); Karatta, 14.xi.1885; Karatta, 14.xi.1886; Grassy Creek, 26.ii.1886 (AD 966100718, syn.); Karatta, 10.xi.1886; Karatta, K.I. (AD 97424442, syn.); Kangaroo I. (AD 97424445, MEL 58682, syn.).

Vernacular names

"Dodder-laurel", Ewart (1931); "Spilled Devil's Twine", Ingram (1941); "Blackfellow's Twine", Bourke (1953); "Devil's Twine", Burbidge & Gray (1970); "Downy Dodder-laurel", "Rusty Dodder-laurel", Willis (1972).

Stem (0.3-) 0.5-1.5 (-3) mm thick, smooth to rugulose, pubescent to glabrescent, young shoots white or red retrorsely pubescent to woolly, yellow-green, grey-green to reddish. *Haustoria* ellipsoid, 2-3 x 1-2.5 mm. *Leaves* either ovate-peltate or triangular-basifixed; if ovate sometimes constricted medially, acute or obtuse; if peltate, 1.5-4 x 0.9-2 mm, honey-green, glabrescent to pubescent with or without cilia, woolly, occasionally with a gland centrally; if triangular, c. 1.5 x 1 mm, drying dark brown. *Inflorescences* mostly single, often paired, sometimes fasciculate or paniculate. Panicles to 100 mm long, longer if stem bearing lateral peduncles also terminates in a spike or raceme. Peduncles 3-30 (-130) mm long, slender or thick, 0.5-1.2 mm thick, when long stem-like, 2-15 (or more) flowered, pubescent, hairs less than 0.3 mm long, yellow or white and more or less tinted red, adherent or patent, straight or curly. Supporting bract similar to leaves, reflexed; bracteoles ovate, more or less acute, keeled, c. 1.5 x 1 mm, pubescent to glabrescent, more or less ciliate, often unequal in size. *Flowers* ovate to obovate, 1-2.9 x 1-2 mm, sessile or pedicellate, in an almost sessile or well elevated loose or somewhat congested head, often when elevated one or two flowers below remote or all well-spaced on shorter or long peduncle. Floral bracts verticillate or in two planes, ovate, acute, mostly narrower than wider, 0.7-1.5 x 0.8-1.5 mm, more or less peltate, reflexed, sometimes with central gland or triangular, glabrescent, ciliate, pubescent often on both sides, hairs grey, yellow or red, pedicel very short to 1 mm, thin or thick, often hidden by floral bracts. *Sepals* triangular to triangular-ovate, acute, 0.7-1 x 0.5-0.8 mm, pubescent

Fig. 12. *Cassytha pubescens*. A, inflorescences with flowers: A1, loose spike; A2, elevated head; A3, nearly sessile head. B, flower(s) and bracts from same inflorescences as in A. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally enlarged filament; C3, third whorl. D, staminode, showing a portion of the receptacle at the base. E, glands, from front (left) and rear (right) view. F, ovary and lower style showing hairs. G, fruits: G1, pyriform, showing basal bracts and rotate apical leathery perianth; G2, ovate, showing pedicel with basal bract and remote higher bracteoles flanking fruit, glandular ring at base of petals and slightly open orifice; G3, obovate, showing bracteole, slight vertical streaks and leathery perianth; G4, globular, showing bracteoles and leathery perianth with closed orifice; G5, young fruit, ribbed (dried), showing pedicel with basal bract, remote higher bracteole flanking fruit, in upper portion a glandular ring with perianth. H, stone, from globular fruit (G4), showing hairs on lower half of style. I, young shoot with scale leaves. J, scale leaf showing hairs: J1, side view; J2, front view. K, habit drawing: K1, smooth stem with young shoot; K2, verrucose stems.



to glabrous, ciliate, honey-yellow to brown, in fruits black, often sunken in glandular ring. *Petals* obovate to ovate, subacute, 1-2 x 0.9-1.5 mm, pubescent, hairs grey, black, yellow or red, short or long, patent or appressed. Fertile *stamens* white like the staminodes and glands, turning brown; stamens of the first whorl ovate, dorsiventrally flattened, 0.7-2.5 x 0.8-1.5 mm, cells obcordate, tip blunt, wide, incurved, filament under cells laterally expanded into arcuate velum, often pointed, sometimes pubescent dorsally, ciliate; stamens of the second whorl oblanceolate, 0.7-1.5 x 0.4-0.5 mm, cells ovate, more or less bulging, tip blunt, incurved, filament narrower than cells; stamens of the third whorl fusiform, 0.6-1 x 0.3-0.5 mm, commonly the cells the widest part and bulging over the glands; tip blunt, more or less incurved. Staminodes pyramidal, cordate or ovoid, 0.3-0.7 x 0.2-0.3 mm, with or without a more or less conspicuous white apical gland. Glands ovoid, 0.3-0.6 x 0.2-0.3 mm, often dorsi-ventrally flattened and crested with a white gland. *Ovary* fusiform, 0.7-1.6 x 0.3-0.5 mm, glabrous or variously pubescent. Receptacular tube pubescent inside. *Fruit* globose to obovoid, (6-) 7-8 (-9) x (4-) 5-6 (-7) mm (dried; when fresh 1.5-2 mm wider), grey, green-grey to green-red, glabrescent to heavily pubescent, indumentum white and mixed red, often broadly streaked, alternately dull-green and dull-red-brown and 6 raised longitudinal ribs more or less protrude; sometimes topped by a flat glandular ring. Floral bracts verticillate or in two planes; if pedicel distally widened then bracteoles flanking base of receptacular tube immersed or more or less patent; fruit drying grey-black or brown or red-black to black. Stone globose to obovoid, c: 4.5 x 3.5 mm, dark-brown to black. (Fig. 12.)

Distribution (Map 7)

Widespread over south-eastern Australia and probably New Zealand, but not entering arid zone. In Queensland south of Tropic of Capricorn, south-west of Rockhampton, west and south of Roma, along the coast south from Fraser Island to Brisbane; in New South Wales along the coast from Coolangatta to Kiah, westwards near St. George, Tottenham, southwards to Albury; in Victoria along the coast from Cape Howe west to Nelson, inland in Gippsland, westwards passing Benambra, Melbourne, Halls Gap, Kaniva north near Pine Plains Homestead; in South Australia south from Mt Gambier along the coast to the top of Gulf of St Vincent, inland from Bordertown and Pinaroo westwards to Tarlee and Cape Jervis, Kangaroo Island and Adelaide. Scattered isolated localities extend westwards in the south-west tip of Yorke Peninsula, Mabel Range in Southern Eyre Peninsula and most westerly c. 20 km south of Yardea where these collections are clearly distinguishable from nearby *C. peninsularis*.

Flowering

Flowering period appears to be unusually long, through summer from Dec.-April, flower buds are formed as early as Aug.; fruits develop slowly from March-April and are shed mostly in Dec.

Affinities

Considerable problems have been experienced in determining the status of specimens here treated under *C. aurea* and *C. pubescens*. They occupy two quite distinct areas: Western Australia from Wagin to the Northern Territory on the one hand and southern Queensland through New South Wales and Victoria, Tasmania to South Australia on the other. At no point do these ranges approach one another to within less than 2,000 km. In the western and north-western species, three moderately distinct subspecific taxa can be distinguished; in the east and south-east species the range in morphological variation is such that no useful taxonomic subdivisions appear to be justifiable. Separation of the western and eastern populations from one another cannot be achieved on the basis of any single character, particularly because of the great variation in the eastern species. However, because of the biological significance of this geographical disjunction, because

of the practical difficulties which would result in recognizing the three western taxa if the whole complex was to be united in a single species, and because of the facility of identification resulting from the geographical separation, it has been decided to maintain two species. In practice these can best be recognized by the occurrence of *C. aurea* only in WA and NT and *C. pubescens* in only Q, NSW, VIC, TAS and SA. The characters used in combination to separate these species are (as indicated in the key):-

- (1) White apical glands present or absent on staminodes and glands
- (2) Size of the flower
- (3) Floral bracts verticillate or in two planes.
- (4) Presence or absence of glandular ring on the fruit.

Similarities

Similarities with *C. filiformis* show in the stem, inflorescence, flowers and indumentum; in distribution these species overlap in Queensland and New South Wales north of 32° S. latitude, but *C. filiformis* differs in having glabrous petals and fruits which are always globose and drying black.

Similarities with *C. rufa* are discussed under that species.

Morphology

Variation in the inflorescence, flowers, fruits and indumentum is great, probably partly due to the wide geographical distribution and isolation of populations. The different morphological characters are not confined exclusively to one area but occur to different degrees in both remote and neighbouring populations. Specimens from Queensland and the north-east corner of New South Wales have rather long peduncles to 10 cm, remote flowers, floral bracts usually verticillate in flower but in two planes in fruit; fruits rather large, c. 9 x 7 mm, if pyriform they are topped with a glandular rim, or globose and glabrescent or pubescent with quite dense white and red striae, red indumentum over more or less bulging ribs. In the Dividing Ranges in New South Wales and eastern Victoria (Gippsland) the peduncles are mostly single, generally 20-30 mm long, flowers in loose heads, fruits c. 6 x 4 mm, more globose, grey and red pubescent, ribs more or less prominent, glandular rim smaller, floral bracts mostly in two planes (split) in flower and fruit. Coastal specimens mainly have longer peduncles (to c. 50 mm), tend to be more pubescent, generally longer hairs and grey and red flowers mostly loose along peduncle, inflorescences often paired or fasciculate to paniculate, fruits c. 7 x 6 mm, obovate with conspicuous glandular rim, ribs more or less prominent, floral bracts verticillate in flower, in two planes in fruit. In Victoria west of Gippsland and eastern South Australia, the inflorescence is usually single, rarely twin, 5-15 mm long, flowers regularly sessile in a loose to congested head, fruit globose, c. 7 x 5 mm, grey-pubescent, including heavily pubescent specimens in Tasmania, but specimens with distinctly pedicellate flowers and paniculate inflorescence were collected on Mt Lofty (South Australia). Rugulose stems are common to a greater or lesser degree in New South Wales, Victoria and South Australia, particularly on Kangaroo Island, where due to big warts the stem is to c. 3 mm thick; the warts making to $\frac{1}{4}$ of the stem, but smooth stems on the same specimens are not uncommon. Young shoots are all pubescent (except a single collection—*L. Durrington* 1237, Moreton Island, 11.x.1973), the peduncles whether thin or thick, are regularly pubescent as well as the bracts, sepals and petals to a certain degree. The indumentum on similar plants from adjacent localities vary in length and colour, and even on different parts of the same plant (young shoots and inflorescences). (Observed also on New Zealand specimens). The androecium, except in size, irrespective of the locality, is fairly homogeneous except occasionally in pubescence; this including the staminodes and glands. In most specimens the ovary is pubescent to a certain degree, indumentum is not related to geographical or other morphological characters. The fruit

in all stages is pubescent, but in the mature stage the hairs may be very sparse (coastal Queensland specimens). (I have never seen a completely glabrous fruit). Systematic treatments separated *C. paniculata*, *C. phaeolasia*, *C. pubescens*, *C. remotiflora*, *C. rugulosa* and *C. tasmanica* mainly on the indumentum, which has been found to be one of the most variable characters. Brown (1810) 404, distinguished *C. pubescens* from *C. paniculata* on branching of the inflorescence, density of the indumentum and shape of the fruit (angular-furrowed or not). Meisner (1864) 252 and 255, described *C. tasmanica*, with dense indumentum, the "Capitatae" group; *C. remotiflora* and *C. rugulosa* were described in the "Spicatae" along with *C. pubescens* and *C. paniculata*. Bentham (1870) 310-311, realizing similarities in the stem and inflorescence and the variability in pubescence, placed *C. rugulosa* and *C. tasmanica* under synonymy in *C. pubescens*. In the key on account of the pubescence, he segregated *C. pubescens* from the "Glabrous or nearly so" *C. paniculata* and raised Mueller's variety of *C. paniculata* var. *phaeolasia* to a species. He also reduced *C. remotiflora* as "slightly pubescent" to a variety of "glabrescent" *C. paniculata*. Specimens, including the types, always have an indumentum on the stem, especially when young, and on inflorescence, flowers and fruits. The diversity in the composition of the inflorescence with elongated and multiplied peduncles, fasciculate and paniculate forms is not expressed as a geographical nor morphological pattern, nor are characters of the indumentum. The present author, dealing with ample material, found it impossible to subdivide this complex satisfactorily.

Specimens examined

QUEENSLAND: *Bancroft s.n.* (BRI 176705). *Biddulph s.n.* (MEL 58707). *Blake 15947* (BRI). *Briggs 2170* (NSW). *Chisholm s.n.* (MEL 58699). *Clemens s.n.* (BRI 1777828, NY). *Coveny 2008* (BRI, NSW). *Durrington 1237, 1430, 1492* (BRI). *Everist 7749, 10076* (BRI). *Field Nats Excursion s.n.* (BRI 177837). *Fletcher s.n.* (NSW 135123). *Francis s.n.* (BRI 177506). *Gittins 942* (BRI, NSW). *Harrold 112* (BRI). *Hockins 574* (BRI); *s.n.* (BRI 103216). *Hubbard 4421* (BRI, K). *Longman s.n.* (K). *Mueller s.n.* (K). *Petrie 75* (BRI). *Simmonds s.n.* (BRI 112858). *Taylor s.n.* (BRI 062235). *White 6377* (BRI, NY); *s.n.* (BRI 177492, 177499, 177505, 177509, 177833).

NEW SOUTH WALES: *Adams 1517* (B, CANB, MEL, NSW). *Backhouse s.n.* (K). *Barker 1658* (AD, NSW). *Barnes s.n.* (NSW). *Batt s.n.* (MEL 52340). *Beckler 57, 70* (MEL). *Bediscombe 86* (CANB). *Betche s.n.* (MEL 58508, NSW 135115). *Blakely s.n.* (NSW 135002, 135020, 135128). *Boorman s.n.* (NSW 135022, 135057, 135114). *Bourke s.n.* (NSW 134999). *Burbidge 6274* (B, BRI, CANB). *Burgess s.n.* (SYD). *Caley s.n.* (BM). *Cabbage 1112, 1395* (NSW); *1747, 2001, 3034, 4079* (NSW, SYD). *Camfield 58* (NSW); *s.n.* (BRI 177489, NSW 135021, 135050-1, 135053, 135058, SYD). *Campbell s.n.* (CANB 15585). *Carolin 3720, 3785, 8000* (SYD). *Carrick 3259* (AD, CANB); *3271* (AD, BRI, K). *Chapman s.n.* (SYD). *Cheel s.n.* (NSW 135019, 135048). *Chippendale & Constable s.n.* (AD 97505512, NSW 29287). *Cleland s.n.* (AD 97424439, 97424447). *Collie s.n.* (NSW 135127). *Comb s.n.* (BRI 177516). *Constable 5536, 6898* (NSW). *Cousins 154* (NSW); *s.n.* (NSW 135047). *Coveny 2430, 4670* (NSW); *s.n.* (NSW 127718, 135014, 135015, 135017, 135061). *Craven 604* (CANB, CHR, K, L, MEL, NSW). *Cumpston s.n.* (OXF). *Day s.n.* (CANB 10499). *Dunn s.n.* (NSW 134545). *Duryer 741* (NSW). *Evans s.n.* (SYD). *Fawcett 135, 196* (MEL). *Fletcher s.n.* (NSW 135007, 135126). *Ford s.n.* (NSW 135010, 135054, 135062). *Forest. Comm. s.n.* (NSW 134543). *Foster 1421* (BRI, CANB, NSW). *Fraser & Vickery s.n.* (NSW 106391). *Fraser s.n.* (NSW 135068). *Garland s.n.* (MEL 58727). *Glenfield Veterinary Res. Inst.* (NSW 134544). *Gray & Costin 3553* (CANB). *Gray 5480* (CANB, NSW). *Haegi 1421* (AD, NSW). *Hamilton s.n.* (NSW 134504, 135005, 135006, 135008, 135009, 135052, 135113). *Hartley 158* (CANB). *Hochreutiner 3053* (G). *Holland s.n.* (SYD). *Hopkins s.n.* (NSW 135112). *Ingram 1416, 2478, 3100, 5462, 5703, 5801, 6303, 8387, 6846, 10046* (NSW); *s.n.* (NSW). *Jackson 2182* (AD, BM, K); *2211* (AD, MEL, PERTH); *2214* (AD, LY, NY); *2235* (AD, HAL, P). *Jephcott s.n.* (MEL 58557). *Johnson 229, 256* (NSW); *s.n.* (NSW 135023, 135059). *Johnson & Constable 1400* (AD, NSW) *s.n.* (NSW 30372). *Kinnia s.n.* (NSW 135033). *Lamont 122* (BM). *Lauterer s.n.* (BRI 32957). *Leichhardt s.n.* (NSW 135116). *Lithgow s.n.* (NSW 135011). *Lawson s.n.* (SYD). *Maiden s.n.* (NSW 135001, 135063); *s.n.* (LY, MEL 58553, NSW 135000). *Mc Barron 4329, 5205, 9496* (NSW). *Mc Donald s.n.* (NSW 135110). *Mc Gillivray 1140* (NSW). *Mc Kay 6907* (CANB, SYD); *8876* (CANB, NSW). *Mc Kie s.n.* (NSW 135111). *Mills s.n.* (NSW 135025). *M'L. Marsh s.n.* (NSW 135524). *Moore 1572, 2067, 3136* (CANB). *Moricand s.n.* (G). *Morrison 5219, 5439* (K). *Mueller (251)* (MEL 58661); *(331)* (MEL 58503, 58520); *s.n.* (MEL 58541, 58543, 58544); *s.n.* (K, MEL 52334); *s.n.* (K). *Musson 32* (MEL). *Myall Lakes Expedition* (SYD). *Nash 27* (AD, PERTH); *s.n.* (AD 97223050, 97223051, 97223052). *Newman s.n.* (SYD). *Pullen 2304* (CANB, NSW). *Ravenscroft s.n.* (MEL 52335). *Reader 17, 19, 23* (MEL). *Rickard s.n.* (OXF). *Rodway s.n.* (K, NSW 135013); *s.n.* (NSW 134982, 135012, 135055, 135056, 135064, 135065, 135066, 135067, 135117). *Rumsey 155* (NSW). *Salasoo 715, 2672, 2966* (NSW). *Schodde 3456* (AD, CANB, NSW). *Solling 235* (NSW). *Tate s.n.* (AD 97424448). *Taylor s.n.* (SYD). *Thom 32* (MEL). *Thompson s.n.* (NSW). *Tindale s.n.* (NSW 135018). *Voyage du Capitaine Baudin* (K). *Walker s.n.* (OXF). *Webb s.n.* (TCD).

Weber 5236 (AD, CANB, NSW, PERTH). *White 3564* (NSW). *Vickery s.n.* (NSW 106390). *Wools s.n.* (MEL 59560). *Wright s.n.* (NY).

VICTORIA: *Adamson s.n.* (MEL 58608). *Aston 750* (MEL); 993 (BRI, MEL); 1282, 1683 (MEL). *Barton s.n.* (MEL 58513-4). *Beaglehole 4654, 9651, 9844, 9860, 17294, 17682, 17684-6, 21117, 21779, 22061, 35237, 35291, 35384* (BEAUGLEHOLE); 28872, 31021, 32227, 32255, 42939 (AD, BEAUGLEHOLE). *Belcher 141* (AUCK, MEL). *Belche s.n.* (NSW 135040). *Carrick 3032* (AD, MEL, NY, W). *Chorney 504* (AD, BM, P). *Connor s.n.* (MEL 58578). *Davies 87* (AD); *s.n.* (MEL 58717). *Day s.n.* (CANB 10500). *Haegi 644* (AD, G, Z). *Hart s.n.* (MEL 58576). *Hochreutiner 3031* (G). *Hornsby s.n.* (AD 97826045). *Howitt 235* (MEL); *s.n.* (MEL 58631). *Jaegerman 473* (AD, CANB); 489, 510 (AD). *Jephcott s.n.* (MEL 58644). *Kuntze 20/130* (NY). *Livingstone & Stirling s.n.* (MEL 58566). *McLennan s.n.* (MEL 58384 & 58569). *Morrison 5072* (NSW, PERTH); 5074 (AD, BRI, NSW, PERTH); *s.n.* (AD 96412053, BM, BRI 80425, CANB 50233, PERTH). *Mueller (238)* (NY); *s.n.* (MEL 58562, 58567, 58568 & 58570). *Nash s.n.* (AD 97216239). *Reader 3, 12, 27* (MEL); *s.n.* (G, MEL 58563). *Thom 15* (MEL). *Sayer s.n.* (MEL 58708). *Smith M.50* (BRI). *Stear s.n.* (NSW 135037). *Stirling 15* (MEL). *Sullivan 1* (MEL). *Symon 55, 1679* (ADW). *Tilden 764, 1017* (BM, G). *Tonnies s.n.* (AD 97424291). *Wallace 18, 54* (MEL). *Walter 1710* (B); *s.n.* (NSW 135038, 135039). *Webb s.n.* (G). *Weber 3719* (AD, BRI, CANB); 5237 (AD, B, G, K, P). *White s.n.* (BRI 177497). *Williamson 6* (MEL); *s.n.* (NSW 135041). *Willis s.n.* (MEL 52336). *Wilson 48* (MEL); 1329 (AD, PERTH). *Wooster s.n.* (MEL 58701). *Anon, Mt Martin* (G).

TASMANIA: *Barker 917, 937* (AD). *Beadle s.n.* (SYD). *Bufton 22* (MEL). *Chinnock 2156* (AD, HO). *Cleland s.n.* (AD 96804787). *Curtis s.n.* (HO 7442). *Davies 1263, 1367* (MEL). *Gould 20* (CANB, HO). *Grave s.n.* (MEL 58683). *Gunn 532/1842* (BM, NSW); 532 (HO); *s.n.* (TCD). *Eichler 16847* (AD, B). *Hemsley 6034* (NSW). *Hooker s.n.* (MEL 58525). *Ising s.n.* (AD 96601090). *Lemann 9388* (BM). *Long 372, 472* (CANB); 522 (CANB, HO). *Lucas s.n.* (NSW 135031). *Maiden s.n.* (NSW 135032). *Maiden & Cabbage s.n.* (NSW 135030). *Milligan s.n.* (HO 7445). *Nelson s.n.* (BM). *Rodway s.n.* (CANB 3784, HO 7449, 7452, NSW 135027-9). *Sharman s.n.* (HO 7443). *Sieber 218* (BM, G, HAL, K, P, PR). *Spicer 4* (OXF). *Story s.n.* (MEL 58548, 58550-1, 58733). *Stuart s.n.* (MEL 58545). *Anon, South Port* (MEL 58535). *?Herb. Hooker s.n.* (TCD). *Anon 653* (MEL); 1693 (MEL).

SOUTH AUSTRALIA: *Alcock 3002* (AD); 3065 (AD, K); 4032, 4535, 5524 (AD). *Bates 284* (AD, BRI); 409 (AD); *s.n.* (AD 97615024). *Beek 114* (AD). *?Behr 49* (MEL); *s.n.* (MEL 58524, 58531). *Chinnock 1, 2, 2452* (AD). *Cleland s.n.* (AD 966090653, NSW 135033). *Copley 1803* (AD). *Czornij 686* (AD, NY); 692 (AD, MTJB, UV). *Donner 972* (AD); 1171 (AD, TCD); 2235 (AD, M); 3819 (AD, NY); 4028 (AD, BM); 4766 (AD, G, NY); 5056 (AD, OXF). *Eardly s.n.* (ADW 5020). *Eichler 12136, 12156, 12175* (AD); 14357 (AD, NY, PRE); 14509 (AD); 15340 (AD, G); 15522 (AD, K); 16244 (AD, G, H, W); 16263 (AD); 16363 (AD, UC); 17667 (AD, B, MEL, NSW); 18593 (AD, BRI, CHR); 19117 (AD, CANB, NSW, PERTH). *Fieldhouse 48* (AD). *Haegi 377, 387, 446, 468, 493, 500, 533, 543* (AD). *Headle 81* (AD). *Hunt 220, 535* (AD). *Ising s.n.* (AD 96451068, 966021431, 966021434, 96605334, 96935026, 9709348, W). *E. Jackson 578* (AD, WRSL); 673 (AD, NT); 2337 (AD, MEL, OSH); 2406 (AD). *G. Jackson 723, 914, 960, 961, 963, 975, 977, 997, 1005, 1006, 1007, 1009, 1011, 1023* (AD). *Jaegermann 518* (AD, HO). *Koch s.n.* (NSW 135034, PERTH). *Kraehenbuehl 1565* (AD, K, L, ULT); 2710 (AAU, AD). *Kuchel 1165* (AAU, AD, JUNGE); 1179 (AD, M). *Lea s.n.* (BM). *Lothian 1019, 2893* (AD). *McFarland s.n.* (AD 96739028, 97021002). *Menzel s.n.* (AD 97424441, 97424450). *Mueller s.n.* (MEL 58523, 58526-30, 58533, 58540, 58554, 58555). *Nash 1* (AD, CANB); 10 (AD, NT). *Orchard 107* (AD); 1816 (AD, B, HAL). *Perry s.n.* (CANB 19441). *Purdie 179b* (AD). *Reader s.n.* (BM). *Riedel s.n.* (AD 96050335). *Roach 45* (AD). *Rogers s.n.* (NSW 135035). *Schodde 1062* (AD, CANB, P). *Sharrad 356, 616, 634* (AD). *Smith 934* (AD). *Southcott s.n.* (AD 97317235, 9732143, 97329074, AK, BISH, CHR). *Specht 32* (AD). *Spooner 1521, 3049, 3975, 4387, 5416, 5468, 5475* (AD). *Symon 1272* (ADW); 2937 (ADW, K); 6805 (AD, ADW, CANB, L); 10531 (AD, ADW). *Tepper 11, 46, 49* (AD); 46 (MEL); *s.n.* (AD 97424442, 97424445); *s.n.* (MEL 58682). *Wheeler 137* (AD, NCU); 165 (AD). *Weber 1576* (AD, CANB); 2022 (A, AD, B, BM); 2033 (AD, MEL); 3035 (AD); 3036 (AD, BRI, NSW); 3543, 3664 (AD); 4348 (AD, MEL); 4411 (AD, CANB); 5233 (A, AD, B). *Whibley 426* (AD, NT, PERTH); 1285, 1680 (AD); 2065 (AD, CANB, NSW); 2785 (AD, MEL); 2900 (AD, HO, WU); 3603 (A, AD, UPS); 3902 (AD, W, Z); 4117 (AD, TRN, UC); 4178 (AD, OSH); 5821 (AD, L). *Williams 2099, 5415, 6458* (AD). *I. Wilson 770* (AD, G, PR). *P. Wilson 732* (AD); 942 (AD, PERTH); 949 (AD); 1130 (AD, HO, NT).

AUSTRALIA: *Atkinson 13* (MEL). *Brown s.n.* (NY). *Caley s.n.* (G). *Leschenault s.n.* (BM). *L'hotsky s.n.* (HAL 42846, OXF). *Meebold 3225, 3253, 10071, 10075* (M). *Sieber 218* (BM 23, G, HAL 42845, K, M 311/24); 218, 821 (MEL 58423, 58425, NY 31/152, P, PR). *Venienat s.n.* (G). *Anon s.n.*, Nov. Holl. (PR).

NEW ZEALAND: *Cheeseman s.n.* (NY). *Chinnock 1373* (AD, AK); 1374 (AD, CANB, CHR). *Kirk 514* (AD, OXF); *s.n.* (NY). *Orchard 3569* (AD, AK). *Powell s.n.* (AK, NSW 134970). *Anon 102* (G).

7. *Cassytha filiformis* L., Sp. Pl. 35 (1753); R. Br., Prod. Fl. Nov. Holl. 403 (1810); Spreng., Syst. Veg. 271 (1825); Wallich, Pl. Asiat. Rar. 2(8): 69 (1831); Nees, Syst. Laur. 642 (1836); Meisn. in DC., Prod. Syst. Nat. Regni Veg. 15: 255 (1864); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); Hook. f., Fl. Brit. India 5: 188 (1885); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Trimen, Handbook Fl. Ceylon 3: 455 (1895); F. Muell., Sec. Syst. Census Austral. Pl. 7 (1889); Bailey, Queensland Fl. 4: 1314 (1901); Maiden & Betche, Proc. Linn. Soc. N.S.W. 34(2): 364 (1909); Stapf in Thiselton-Dyer, Fl. Cap. 5: 500 (1912); Stapf in Thiselton-Dyer, Fl. Trop. Africa 6: 188 (1913); Bailey, Compr. Cat. Queensland Pl. 437 (1913); Maiden & Betche, Census N.S.W. Pl. 82 (1916); Ewart & Davies, Fl. Northern Terr. 113 (1917); Ridley, Fl. Malay Peninsula 3: 137 (1924); Domin, Biblioth. Bot. 22(89): 679 (1925); Gardner, Enum. Pl. Aust. Occ. 44 (1931); Allen, J. Arnold Arb. 23: 154 (1942); Kostermans in Humbert, Fl. Madagascar. 81: 85 (1950); Sastri, Ind. Bot. Soc. 31: 240-246 (1952); Hutchinson & Dalziel, Fl. West Trop. Africa ed. 2 1(1): 58 (1954); Sastri, Proc. 44th Ind. Sc. Cong. :III, abstr. 240 (1957); Sastri, Bot. Gaz. 123(3): 197-206 (1962); Kostermans in Backer & Bakhuizen van den Brink, Fl. Java 1: 135 (1963); Sastri, Ann. Bot. n.s. 27: 425-433 (1963); Chakravarty, Bull. de l'I.F.A.N. ser. A 752, t. 31 (1969); Long & Lakela, Fl. Trop. Florida 422 (1971); Ross, Fl. Natal 172 (1972); Chang in Fl. Taiwan 2: 409, t. 354 (1976); Schroeder, Calif. Avocado Soc. Yearb. 62: 126-129 (1978).

Lectotype: Rheede, Hort. Ind. Malab. 7: t. 44 (1688). See Notes.

C. archboldiana Allen, J. Arnold Arb. 23: 155 (1942).

Type: L.J. Brass 11675, Balim River, 1600 m alt., (New Guinea), Dec. 1938 (A, holo., n.v.; BRI 009565, iso.).

C. filiformis var. *pseudopubescens* Domin, Biblioth. Bot. Band 22, Heft 89(2): 680(126) (1925).

Type: K. Domin 4200, Emu Park near Rockhampton (Australia), Dec. 1909 (PR 526768, lecto.; BRI, iso.). K. Domin 4199, coast near Brisbane (Australia), Dec. 1909 (PR 526762, syn.). K. Domin 4208, Dividing Range near Pentland (Australia), March, 1910 (PR 526769, syn.).

C. melantha non R. Br. sensu Ewart & Davies, Fl. Northern Territory 113 (1917) quoad spec.: G.F. Hill 509, Tungiegi Waterhole (Australia), 10.viii.1911 (MEL 58482).

C. novo-guineensis Kanehira & Hatusima, Bot. Mag. Tokyo 57(677): 190 (1943).

Type: R. Kanehira & S. Hatusima 12950, Waren, c. 100 km south of Manokwari (New Guinea) 21.iii.1940 (FU, iso.).

C. timoriensis Gandoger, Bull. Soc. Bot. France 60: 519 (1913).

Type: Zipel, Insula Timor, 1865 (LY, holo.; LY, iso.).

The following non-Australian names have appeared as synonyms of *C. filiformis* L. in the literature, but their types have, for the most part, not been examined by the present writer:

C. americana Nees, Syst. Laur. 644 (1836) (vide Stapf [1912]).

C. aphylla Raeusch, Nom. ed. 3: 116 (1797) (vide Kostermans [1950]).

C. brasiliensis Mart. ex Nees, Syst. Laur. 648 (1836). (vide Kostermans [1950]).

C. dissitiflora Meisn., Kjoeb. Vidensk. Meddel 145 (1870) (vide Kostermans [1950]).

C. filiformis var. *subpubescens* Meisn. in DC., Prod. 15: 255 (1864) (vide Allen [1942]).

C. guineensis Schumacher in Beskr. Guin. Pl. 199 (299) (1827) (vide Stapf [1913]).

C. senegalensis A. Chev., Fl. West Trop. Africa 1: 46 (1938) (vide Hutchinson [1954]).

C. zeylanica Gaertner, Fruct. 1: 134 (1788) (vide Kostermans [1950]).

Names, other than *Cassytha*, applied are:-

Calodium cochinchinense Lour., Fl. Coch. 247 (1790) (vide Kostermans [1950]).

Volutella aphylla Forsk., Fl. Aeg.-Arab. 84 (1775) (vide Kostermans [1950]).

Vernacular Names

"Love vine" Long & Lakela, Fl. Trop. Florida 422 (1971), also J. Eldridge, Econ. Bot. 29(4): 316 (1957) for Bahamas; "False dodder", C.A. Smith, Common names of South African Pl. 489 (1966).

Typification of Cassytha filiformis L.

No collection was cited by Linnaeus. *Cassytha* collections in the Linnaean Herbarium (London) consist of three sheets numbered 519-1, 2 & 3 (Savage Index). The first and the last sheet are not annotated and the second originated from South Africa (C B S = Caput bonae spei). As Linnaeus cited the habitat only as India, the annotated sheet cannot be a type. No specimen of *Cassytha* was included in the microfiche of the Linnaean Herbarium (Stockholm).

Linnaeus cited five references:-

- (1) Camel, Herb. Luzone Philipp. in Ray, Hist. Pl. 3, App.: 1 (1704). This is based on a collection made in the Philippines, but the specimen has not been located.
- (2) Petiver, Gazoph. 77, t. 49, f. 12 (1702-4). Petiver also refers to Ray (1704) and to Camel (1704) and may not have been based on further collections. The illustration is poor.
- (3) Plukenet, Alm. Bot. 126, t. 172, f. 2 (1692). This refers to Rheede (1688), but the illustration appears to have been drawn from a different source, probably an original specimen. No specimen in the Sloane Herbarium (BM) can definitely be shown to have been the basis for the illustration or description.
- (4) Rheede, Hort. Ind. Malab. 7, 83, t. 44 (1688). This is apparently based only on material collected in the southern Deccan Peninsula. No Rheede specimens are known, but the illustration is good.
- (5) Ray, Hist. Pl. Suppl. 551 (1704).

As the identification of the species referred to by these authors cannot be based on any known collection, the best choice for a lectotype is the most definitely identifiable illustration. Rheede, Hort. Ind. Malab. 7, t. 44 (1688) is, therefore, made here the lectotype. Only one species of *Cassytha* occurs in India and this agrees with Rheede's figure and description except that the Indian collections are known to have 9 fertile anthers, not 6 as described by Rheede. However, elsewhere in its distributional range, this species does occasionally have only 6 fertile stamens. Indian collections examined by the present author are indistinguishable from specimens from Australia and the presence of *C. filiformis* in Australia is therefore confirmed. Brown (1810) first identified this species in Australia and no other name has ever been proposed for this Australian species.

Stem filiform, (0.2-) 0.6-0.8 (-1.5) mm thick, pubescent to glabrescent, bright yellow-green, orange to dark red, drying irregularly striate and more or less verrucose. *Haustoria* mostly elliptic, 1-2 mm long. *Scale leaves* ovate to triangular subulate, keeled, 1-2.5 x c. 1 mm, glabrous or indumentum white or red, commonly ciliate, light to dark-brown, occasionally with a gland on the upper surface. *Inflorescence* of single, seldom paired or paniculate elevated spikes; peduncles (3-) 13-50 (-100) x c. 0.5 mm, thinner than stem, heavily pubescent to glabrescent, (2-) 4-8 (-16) flowered. Subtending bract triangular to subulate, 1-3 x c. 1 mm; bracteoles similar, smaller, pubescent to glabrescent, ciliate. *Flower* sessile, globular-ovoid, 1-2 x 0.8-1.5 mm. Floral bracts verticillate (in plane); bract ovate to triangular, acute, c. 1 x 0.6 mm pubescent to glabrescent, ciliate; bracteoles similar, smaller. Receptacular tube short, glabrous. *Sepals* triangular, 0.6-1 x 0.5-0.9 mm, pubescent to glabrescent, ciliate. *Petals* ovate, bluntly acute, 1-1.8 x 1-1.5 mm, glabrous on both sides, rarely with appressed papillose pubescence inside, white to green. Fertile *stamens* 9, or 6 when three of the third whorl sterile, white, giving white appearance to the flower, drying brown; stamens of the first whorl angular-ovate, c. 1 x 0.4-0.6 mm, anthers obcordate, c. 0.4 mm across, if filaments expanded laterally and pointed, reaching 0.5-0.6 mm across; stamens of the second whorl fusiform, c. 1 x c. 0.4 mm, anthers obcordate, widest, filament tip inflexed slightly; stamens of the third

whorl oblanceolate, c. 0.7- c. 1 mm long, if fertile, anthers obcordate, c. 0.4 mm across, filament tip deflexed slightly, if sterile then subulate and not more than c. 0.3 mm across, slightly shorter than anthers and straight. Staminodes pyramidal, wedge-shaped on top, white, conspicuously stalked, c. 0.5 x 0.3 mm; glands conical or ovoid, c. 0.35 x 0.25 mm, without white apical gland, in drying turning darker. *Ovary* fusiform, less than 2 mm long and c. 0.3 mm across, glabrous or with ring of hairs in central portion. Receptacular tube glabrous or pubescent inside. *Fruit* ovoid to nearly globular 4-8 x 3-5 mm, glabrous, green or orange to red on maturing, sometimes white, drying commonly black, rarely deep-green with brown vertical stripes; persistent petals vertical or rotate, leathery and brown. Stone globular, 3-4 mm across, dark-grey to black. (Fig. 13.)

Distribution (Map 1)

A pantropic species, it occurs in the tropics and subtropics of both the Old and the New World; in Australia it is distributed in northern regions. The eastern Australian range reaches to nearly 32° latitude south due to the warm coastal climate, but in the west to only 23° latitude south because of cooler and dryer weather conditions. The species is distributed well into arid but warmer regions of Northern Territory and Queensland, but not into the cooler mountains.

Flowering

Flowers all the year round.

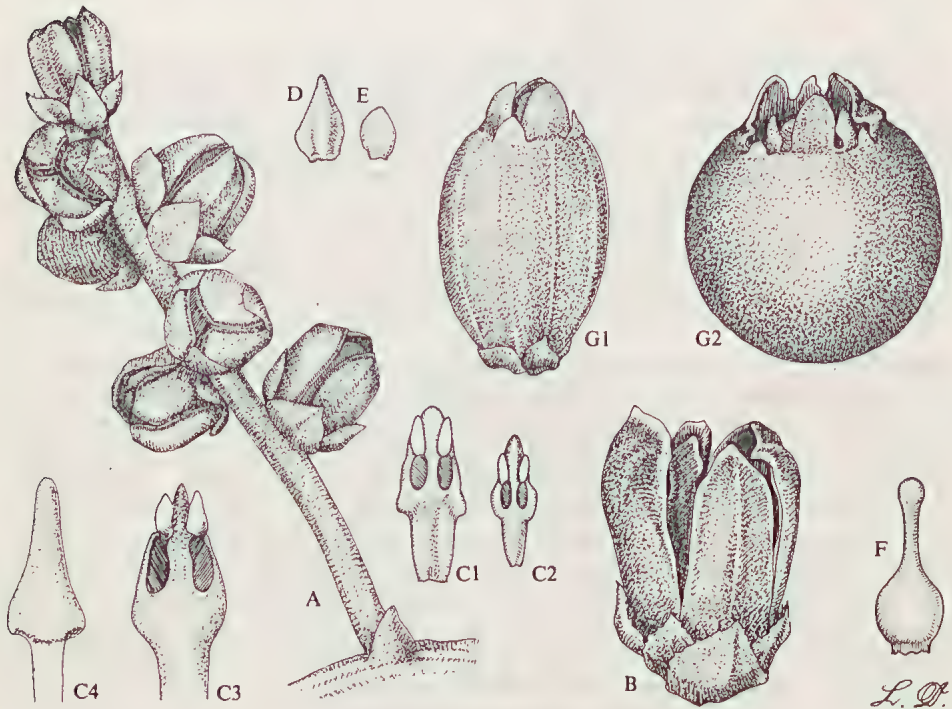


Fig. 13. *Cassytha filiformis*. A, inflorescence in flower. B, flower with bracts. C, stamens, front view showing open loculi and upright flaps: C1, first whorl; C2, second whorl; C3, third whorl; C4, sterile stamen of third whorl. D, staminode. E, gland. F, ovary. G, fruits, showing perianth: G1, ovoid and slightly ribbed lengthwise, showing basal bracts; G2, globose and smooth, showing open orifice.

Notes

Some collections from Northern Australia, having very short peduncles 3-4 mm long and few (3-) flowers, resemble *C. capillaris* (see discussion under *C. capillaris*).

A few unusual forms occur, for example in New South Wales, Indonesia and the Philippines, the plants having a long peduncle (-100mm) bearing numerous remote flowers and the seed maturing basifugally and showing similarities with some specimens of *C. pubescens*, from which they differ in always having glabrous fruit. On some specimens from Queensland the fruits dry dull-green and encrusted with vertical cork-like dark brown lines or stripes. Neither of these forms is sufficiently distinct to justify taxonomic recognition. The appearance as a parasite on many plant species has been observed in many parts of the world such as Mexico, Western Australia, South Africa, New Caledonia, New Hebrides (Schroeder, 1978, p. 128); I have seen it climbing over grasses, bushes and trees.

Identity of C. archboldiana

Allen (1942) described *C. archboldiana* from New Guinea on the basis of its 6 fertile stamens, the sterile being in the third whorl. However, collections with the third whorl of stamens sterile have been made in the Kimberley (Western Australia), Arnhem Land (Northern Territory and eastern Queensland), in the Territory of Papua and a single collection in the Philippines (*E. fenix* Bureau of Science No. 26147, vicinity of Tanculan Bukidnom Subprovince, Mindano, July, 1916). The Philippine collection shows a range in reduction of anthers of the third whorl in a single flower, where one stamen has two cells, another one and the third stamen is fully sterile. The specimen from Queensland (E. Jarvis, Cairns, (Australia), Aug. 1913 [BRI 177517]) has all three stamens of the fourth whorl each with a single cell. It is concluded that the fertility or sterility of the inner stamens does not constitute a good taxonomic character and that *C. archboldiana* must be included in synonymy with *C. filiformis*.

Specimens examined

WESTERN AUSTRALIA: *Beaglehole* 11249 (BEAUGLEHOLE, PERTH); 47358 (BEAUGLEHOLE); 46963, 47398, 47526, 48225, 48237, 48327, 51675, 5264, 53071, 53096, 53214, 53748, 53753, 53980 (AD, BEAUGLEHOLE). *Burbidge* 1452 (PERTH). *Fitzgerald* 230, 691, 1453 (PERTH). *Hnatiuk* MP108 (PERTH). *George* 13364, 13380a, 13454 (PERTH). *Kenneally* 3069, 4436, 5118, 6380 (PERTH). *King* s.n. (AD 97509305). *Marchant* 252 (PERTH). *Rust* 146 (PERTH). *Symon* 10126 (AD). *Weber* 4858 (AD, CANB, PERTH). *Wilson* 10869, 11220, 11442, 11515 (PERTH). (? *Oldfield*) (MEL 58350).

NORTHERN TERRITORY: *Adrick* s.n. (CANB 22199). *Basedow* 9 (AD). *Beaglehole* 46394, 46403, 58186 (BEAUGLEHOLE); 46350, 54668, 54681, 54787, 54893, 59285 (AD, BEAUGLEHOLE). *Byrnes* 1083 (AD, NT). *Chippendale* s.n. (AD, ADW, BRI, CANB, MEL, NSW, NT 987, 4796, 5548, 7008, 8175, 8248). *Hill* 509 (MEL). *Holtze* (313) (MEL). *Latz* 194 (AD, BRI, NT, PERTH); 3304 (CANB, NT). *Letts* s.n. (NSW, NT 8340). *McKean* B110 (BRI, NT). *Mueller* s.n. (MEL 58427). *Must* 929, 946 (CANB, NT). *Ridley* 52 (BRI). *Specht* 166 (AD, BRI); 267, 732, 934, 1047 (AD, BRI, CANB, MEL, NSW, PERTH). *Stocker* 264 (BRI). *Story* 7728 (CANB). *Symon* 7662 (AD, ADW, CANB); 7717 (AD, ADW, CANB, NT); 7719 (AD, ADW); 7724 (ADW); 7734 (AD, ADW); 7771, 7783 (AD, ADW, CANB); 7821 (ADW); 7929 (AD, ADW); 7944 (ADW). *Weber* 1069 (AD, NT, PERTH). *Went* 115 (BRI).

QUEENSLAND: *Bailey* 364 (BRI); s.n. (BRI 176685, 176686, 176693 & 177519, 177840). *Banfield* s.n. (NSW 135087). *Baxter* 758 (BRI). *Beaglehole* 55009 (AD, BEAUGLEHOLE). *Bertland* s.n. (MEL 58702). *Betche* s.n. (NSW 135086). *Bick* s.n. (BRI 177495). *Birck* s.n. (MEL 58745). *Blake* 1495, 22699, 23464 (BRI). *Brass* 291 (BRI, CANB); 2516 (BRI); 18631 (CANB, G); 19903 (CANB). *Clemens* s.n. (BRI 017602). *Coveny* 1999, 2061, 2078 (NSW). *Cubb* s.n. (BRI 073977). *Curtis* s.n. (BRI 062377). *Dietrich* s.n. (MEL 62396). *Done* s.n. (BRI 147285, 147346, 148969, 149090, 149459). *Dovey* 9 (BRI). *Durrington* 216, 360, 388, 598 (BRI). *Eichler* 20720 (AD, BRI, NT); 20752 (AD, CANB, MEL). *Everist* 7241 (BRI). *Fagg* 674 (BRI). *Flecker* 898964 (NSW). *Fosberg* 41311 (NY); 54963, 55002 (BRI). *Gorton* s.n. (BRI 177822 & 177823). *Harrold* 209, 277 (BRI). *Heatwole* s.n. (BRI 146063, 146358, 146401-2, 146426, 147390, 149027, 149375). *Hubbard* 2328, 2681, 2728, 3142 (BRI). *Hyland* 2149 (BRI). *Isbell* s.n. (BRI 113915). *Jaegermann* s.n. (AD 97730137, MEL, NSW). *Jarvis* s.n. (BRI 177517). *Johnson* s.n. (MEL 58613). *Jones* 1496, 3015 (CANB). *Kingston* s.n. (BRI 086384). *Langdon* s.n. (BRI 177821). *Lawrie* s.n. (BRI 140240, 149950). *Leach* s.n. (BRI 176703). *Longman* s.n. (K). *McDonald* s.n. (BRI 176700). *McKee* 9367 (K, NSW); 10262 (CANB). *Morain* 242 (BRI). *Mueller* s.n. (MEL 58353,

58619). *Nash* 21-23 (AD). *O'Shanesy s.n.* (MEL 58351, 58359, NSW). *Perrys s.n.* (BRI 177502). *Persietz* 39, 109, 209, 337, 961 (MEL). *Purcell s.n.* (BRI 056118). *Rodway s.n.* (NSW 135118). *Ross* 6 (MEL). *Sayer s.n.* (MEL 58739). *Sharpe* 1233 (BRI). *Slater* 51 (CANB). *Smith* 11009 (BRI). *Soutte s.n.* (BRI 177512). *Specht* 194 (BRI). *Stephenson* 661 (BM). *Story & Yapp* 300 (CANB). *Tindale s.n.* (AD 97218203). *Thomson* 144 (K). *Tryon s.n.* (BRI 176704, 177514). *Walker ANU370* (BRI, CANB). *Webb* 761, 2414 (CANB). *White* 12410 (BRI); *s.n.* (BRI 176684, 177490, 177507, 177510-1, 177812). *Whitehouse s.n.* (BRI 176702, 177518). *Anon s.n.*, Dalrymple I. (BRI 177498); *s.n.*, Heron I. (CANB, NSW, SYD); *s.n.*, Ipswich (BRI 177513); *s.n.*, Maroochie (BRI 176682-3); *s.n.*, Whelmsian Port (BRI 177496).

NEW SOUTH WALES: *Boorman s.n.* (NSW 135088, 135090). *Carrick* 3272 (AD, BRI, NSW). *Coveny* 4645, 4651, 5029 (BRI, NSW). *Fawcett* A71 (MEL). *Guilfoyle s.n.* (MEL 58633). *Ingram s.n.* (NSW); 5074, 9457 (NSW). *Johnson s.n.* (NSW 42324). *Rothwell s.n.* (NSW 135119).

EX AUSTRALIA (From 210 examined specimens selected)

AUSTRAL ISLANDS: *Quayle* 280 (BRI). BRAZIL: *Pires & Westra* 48870 (NY). BURMA: *Parker* 2766 (MEL). CAROLINE ISLANDS: *Anderson* 2108 (NY). *Fosberg* 46693 (NY). CEYLON: *Alston* 2396 (BRI). CHINA: *Tsang, Wai-Tak* 3 (LY, NY). CHRISTMAS ISLAND: *Fosberg & Metraux* 13213 (CANB). CUBA: *Palmer* (359) (NSW). FIJI: *Smith* 4743 (BRI). HAWAII: *Degener* 24245 (NSW, NY). HONG KONG: *Wilford* 107 (MEL). INDIA: *Thomson s.n.* (MEL 62334). INDONESIA: *De Haan* 1723 (BO, NY); *Lam* 430J (BO, BRI). JAMAICA: *Harris* 39 (NY). JAVA: *Kuntze s.n.* (NY). LOW ARCHIPELAGO: *Chapin* 810 (NY). MALAYA: *Carrick* 2597 (A, AD, NY, SING). MARIANNE ISLANDS: *McGregor* 444 (NSW, NY). MARSHALL ISLANDS: *Fosberg* 33964 (NY). MOSAMBIQUE: *Marques* 100 (NSW). NEW CALEDONIA: *Schlechter* 15643 (NSW); *Guillaumin* 729 (NY). NEW GUINEA: *Brass* 5795, 8639 (BRI, NY); *Pullen* 1180 (CANB); *Ridsdale NGF* 33530 (A, BISH, BOG, CANB, K, L, LAE, SING). NEW HEBRIDES: *Morrison s.n.* (MEL 62354); *Quaife* 261 (NSW). ONOTOA: *Moul* 8056 (NY). PALAU ISLANDS: *Takamatsu* 1583 (BRI). PAPUA: *White* 61 (BRI). PHILIPPINES: *McGregor* 32513 (BRI). PUERTO RICO: *Little* 21670 (NY). SAMOA: *Christophersen* 1933 (NY). SINGAPORE: *Burkil* 459 (BRI, SING). SOLOMON ISLANDS: *Brass* 3069 (BRI, NY). SOUTH AFRICA: *Maguire* 1681 (SAM). SURINAME: *Irwin & al.* 55954 (NY). TAIWAN: *Tanaka & Shimada s.n.* (MEL 62344, NT, TAI 13519). TIMOR: *Steenis* 18110 (CANB, L). TUAMOTU ARCHIPELAGO: *St John* 14364 (BRI, NY). UNITED STATES OF AMERICA: *Bailey* 6020 (MEL).

8. *Cassyltha peninsularis* J.Z. Weber, sp. nov.

Caulis 0.5-2.6 mm crassus, glabriusculus. *Folia* ovata vel angulato-ovata, 1.5-4 x 0.4-1 mm, peltata, glabrescentia, ciliata. *Haustoria* elliptica, 1-2 x c. 1 mm. *Inflorescentia* singular vel fasciculata et glomerulata, pedunculus simplex vel breviter, divisus, 1-7 x 0.5-1 mm, 1-5 floribus. *Flores* ovoidei, demum obovoidei, 1.7-2.5 x 1-2.3 mm, pedicellati; floris bracteae in planitibus duobus. *Sepala* triangularia vel ovata, 0.9-1.2 x c. 1 mm, raro pubescentia, ciliata; *petala* ovata vel triangulari-ovata, 1.5-2 x c. 1.5 mm, glabriuscula, flava. *Stamina* fertilia 9; stamina ordinis primi ovata, 1.5-2 x c. 1 mm, filamentis alatis; stamina ordinis secundi oblanceolata, 1-2 x c. 0.5 mm, cellulae latissimae; stamina ordinis tertii obovata, 1-1.8 x c. 0.5 mm, cellulae latissimae. *Staminodia* cordata vel pyramidata, 0.6-1 x c. 0.5 mm, apica albo-glandulata vel eglandulata; glandulae ovatae vel obovatae, 0.4-0.8 x 0.3-0.4 mm, apicibus glandulatis vel eglandulatis. *Gynoeceium* pubescentium vel glabrum. *Fructus* globosi vel obovoidei, 7-9 x 5-6.5 mm, pubescentes rufis at albis striatis vel glabriusculi, apicibus annulatis glandulosis, exsiccatis cano-brunneis vel denigratis.

Type: J.Z. Weber 4462, just south of Port Rickaby (34° 41' S; 137° 29' E); 11.xii.1974 (AD 97506118, holo., CANB, MEL, NSW, PERTH, iso.).

Stem 0.5-2.6 mm thick, glabrescent, rarely rugulose, yellow-green, green to green-red. Young shoots pubescent. *Leaves* fleshy, ovate to angular-ovate, 1.5-4 x 0.4-1 mm, peltate, glabrescent, ciliate. *Haustoria* ellipsoid, 1-2 x c. 1 mm. *Inflorescence* raceme or panicle, few to 20 flowered; peduncles single or fasciculate, 1-7 x 0.5-1 mm, 1-5 flowered, fewer flowered shorter. Supporting bract angular-ovate or triangular-ovate, 1-1.5 x c. 1 mm, deflexed, fleshy or leathery, puberulent, ciliate, sometimes with gland basally; bracteoles similar, smaller, glandless; at each division of peduncle a similar set. *Flowers* ovate to obovate, 1.7-2.5 x 1-2.3 mm; pedicel 0.2-1 x c. 0.4 mm, in flower hidden by floral bracts, not enlarged in fruit; floral bracts in two planes; bract triangular or ovate, c. 1.5 x 1-1.2 mm, pubescent, ciliate; bracteoles triangular to ovate, 0.9-1.1 x 0.8-1 mm, mostly pubescent. *Sepals* triangular to ovate, 1-1.2 x c. 1 mm, sometimes pubescent, ciliate, turning brown, leathery in fruit, quite immersed in glandular rim. *Petals* ovate or triangular-ovate, 1.5-2 x c. 1.5 mm, more or less puberulent outside, pubescent inside, yellow in flower, leathery in fruit; receptacular tube pubescent. Fertile *stamens* 9, white, drying brown;

stamens of the first whorl ovate or narrow-ovate, 1.5-2 x c. 1 mm, filament expanded laterally and widest in central position; stamens of the second whorl oblanceolate; stamens of the third whorl obovate, 1-1.8 x c. 0.5 mm, cells widest. Staminodes fleshy, cordate or pyramidal, 0.6-1 x c. 0.5 mm, white, drying brown, with or without white glandular tip; glands ovate or obovate, 0.4-0.8 x 0.3-0.5 mm, white, drying brown, with or without white apical gland. *Ovary* fusiform, 1-2 x 0.5-0.7 mm, glabrous or with ring of hairs medially, stigma capitate, white, brown in fruit. Receptacular tube pubescent inside. *Fruit* obovoid or globular, 7-9 x 5-6.5 mm, pubescent and broadly streaked, alternately dull-green and dull-red or glabrescent and not streaked; topped with glandular rim more conspicuous in dried state. Stone ovate, 4-5.5 x 3.5-4.5 mm. (Figs 14 & 15.)

Distribution (Map 8)

Endemic to South Australia in the Flinders Ranges, Eyre Peninsula, Yorke Peninsula and Kangaroo Island.

Flowering

Flowering from Apr.-March, mature fruits occur throughout the year.

Key to Varieties

1. Staminodes and glands with a white apical gland; ovary with ring of hairs medially; fruit streaked with alternate bands of white and red hairs, drying green and brown . . . 8a. var. *peninsularis*
1. Staminodes and glands without apical gland; ovary glabrous; fruit glabrescent, not streaked, drying black 8b. var. *flindersii*

8a. *Cassytha peninsularis* var. *peninsularis*

Stem (0.5-) 0.7-1 (-2.6) mm thick. *Leaves* ovate, subacute, c. 2 x 1 mm, more or less sprinkled with hairs, often with central gland. *Haustoria* ellipsoid, c. 2 x 1 mm. Supporting bract of inflorescence angular-ovate, c. 1.5 x 1 mm, fleshy, light-brown, maturing black, bracteoles ovate, c. 1.2 x 1 mm. Floral bract ovate, cordate, subacute, c. 1.5 x 1.2 mm, light-brown, turning brown; bracteoles triangular-ovate, c. 0.9 x 0.8 mm, pubescent, ciliate, green to light-brown, turning brown. *Flowers* yellow (1.7-) 2.3 (-2.5) x (1.1-) 1.8 (-2.3) mm. *Sepals* triangular, c. 1.2 x 1 mm, pubescent to only sprinkled with a few hairs, ciliate, light brown. *Petals* ovate, c. 2 x 1.5 mm, glabrous or occasionally only sprinkled with a few hairs outside, yellow, in fruit dark brown. Receptacular tube streaked with 6 alternate vertical bands of dense red and white indumentum. *Stamens* of the first whorl narrow-ovate, c. 2 x 1 mm, cells bulging, tip blunt; stamens of the second whorl c. 2 x 1 mm, tip blunt; stamens of the third whorl c. 1.8 x 0.5 mm, cells bulging over staminodes and glands. Staminodes cordate to pyramidal, laterally compressed, c. 1 x 0.7 mm, conspicuously white-glandular crested; gland obovate, c. 0.8 x 0.5 mm, conspicuously white-glandular tipped. *Ovary* c. 2 x 0.7 mm, with ring of hairs medially. *Fruit* globular, c. 7 x 6.5 mm (dried obovate, c. 7 x 5.5 mm), pubescent, broadly streaked alternately with dull-green and dull red-brown hairs; glandular rim much more conspicuous on dried specimens; drying grey-brown. Stone ovate, c. 5.5 x 4.5 mm, light-brown, drying brown. (Fig. 14.)

Distribution (Map 8)

Endemic to southern South Australia, on Eyre Peninsula from Ceduna and Hiltaba southwards to West Point, on Yorke Peninsula from Moonta southwards and on Kangaroo Island.

Flowering

Flowering from October onwards, fruits start to form from March onwards and are mostly shed in December.

Similarities

The species shows similarities with *C. pubescens* in the short peduncle, yellow coloured petals, white-glandular tipped staminodes and glands, floral bracts in two planes, in the streaked fruit and glandular rim on top. In *C. pubescens* these characters are not all represented on a single specimen, but are scattered throughout different geographical forms. When *C. pubescens* has a short peduncle, the floral bracts are verticillate (in one plane) and the staminodes and glands are not white-glandular tipped;

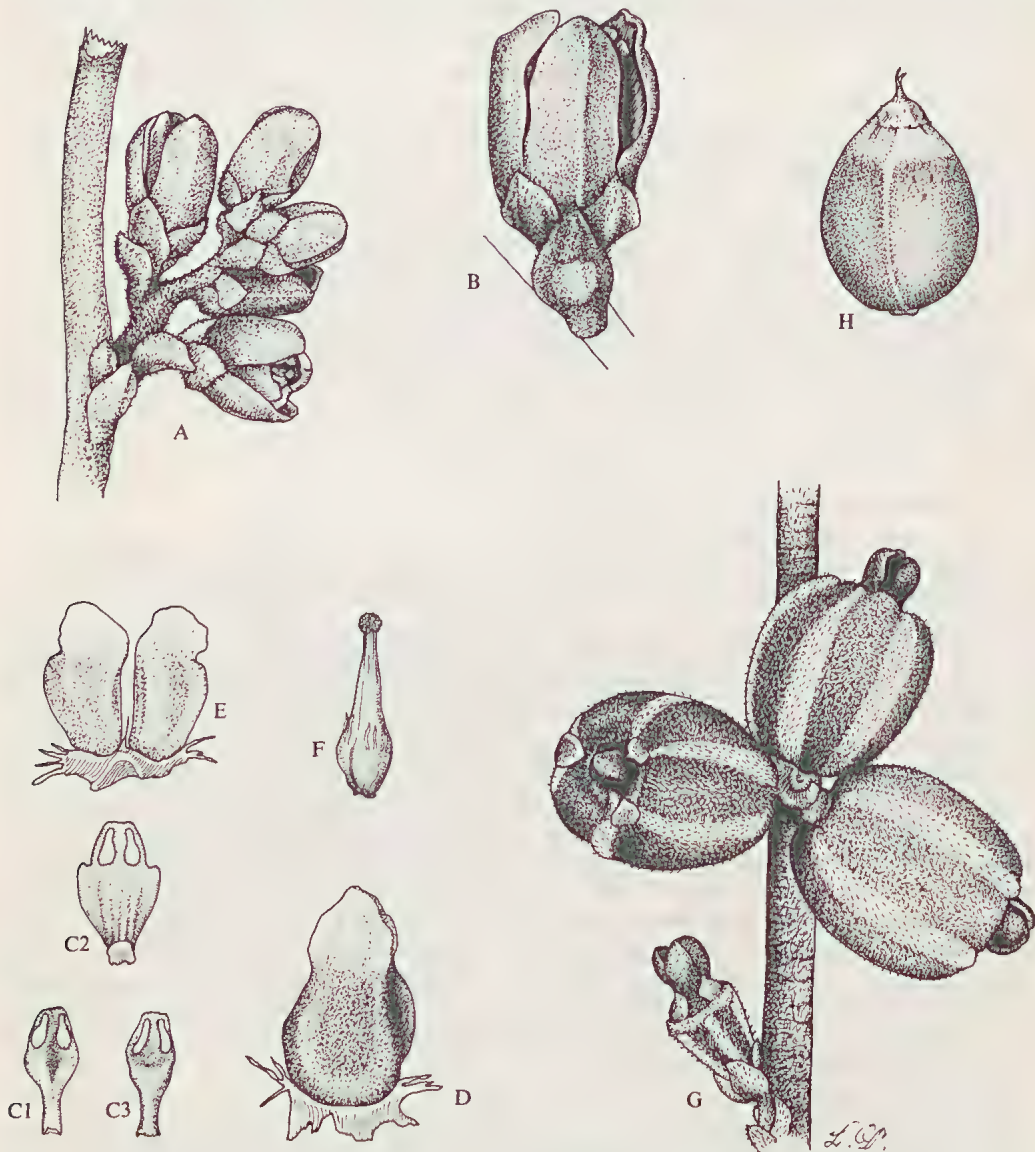


Fig. 14. *Cassytha peninsularis* var. *peninsularis*. A, stem and inflorescence with flowers. B, flower with bract. C, stamens, front view showing loculi: C1, second whorl; C2, first whorl, showing laterally expanded filament; C3, third whorl. D, staminode, side view, showing white apical gland. E, glands, centripetal view, showing white apical gland(s). F, ovary, showing hairs medially. G, fruits, showing short pedicels attached to the peduncle, broadly streaked lines from base to top, glandular apical ring, which is emphasised on young fruit lower and perianth. H, stone.

when the petals are yellow they are heavily pubescent, floral bracts are verticillate and staminodes and glands are not white-glandular tipped; when the fruit is streaked white and red with conspicuous glandular rim on top, the peduncle is over 20 mm long and petals heavily pubescent. These taxa can, therefore, only be distinguished on a combination of characters. This species shows similarities with *C. nodiflora* in the glomerulate inflorescence, yellowish flowers and having staminodes and glands white-glandular tipped, but differs in there being heavily pubescent peduncles in *C. nodiflora*, which has the floral bracts verticillate and glabrous greenish fruit without glandular rim on top nor streaked alternately with white and red stripes. Similarities with var. *flindersii* exist, both having the floral bracts in two planes and glabrescent yellow petals but var. *peninsularis* differs in having pubescent and red and white alternately streaked fruits, white-glandular tipped staminodes and glands, and the ovary being pubescent with a ring of hairs medially.

Note

This is a geographically isolated species, on the eastern side it is separated from populations of *C. pubescens* by the Gulf of St Vincent and on the west from *C. nodiflora* by the Nullarbor Plain. All three species have in common the short peduncles (glomerulate inflorescence) which occurs in some *C. pubescens* specimens in the Mt Lofty Range in South Australia, although other inflorescence types predominate in *C. pubescens* over most of its range.

Specimens examined

SOUTH AUSTRALIA: *Alcock* 1641 (AD, ADW); 2262 (AD); 4562 (AD, PERTH); *s.n.* (AD 96745056). *Andrew s.n.* (AD 97424471). *Barker* 1773 (AD, MEL, PERTH). *Bates* 1399 (AD). *Blaylock* 363, 392, 1196 (AD); 1657 (AD, CANB, NSW, HO). *Black, J.M. (Herb.) s.n.* (AD 97424470). *Brown* 40 (MEL). *Carter s.n.* (ADW 24615). *Chinnock* 1201 (AD, HO). *Copley* 2355 (AD, P). *Eichler* 14162 (AD, LY, P); 15482 (AD, HAL, PERTH); 19161 (AD, AK, BISH, CHR, DELHI); 19287 (AD, G, L); 19324 (A, AD, AK); 19400 (AD, FRIG, GOET); 19419 (AD, CANB, H, L); 19498 (AD, NSW). *Fahlbohm* 89 (MEL). *Haegi* 315, 319 (AD). *Ising s.n.* (AD 97701219). *Jackson* 1004 (AD); *s.n.* (AD 97444193). *Kraehenbuehl* 2056 (AD); 3039 (AD, NT, OSH, TRN). *Kuchel* 1313 (AD); 3335 (AD, W). *Lothian* 1140, 3706, 4058 (AD). *Nash* 30 (AD, BRI, MEL, NSW); 31 (A, AD); *s.n.* (AD 97338072, UC, W, Z). *Mueller s.n.* (MEL 58532). *Orchard* 2982 (AD, LY, P). *Pearce s.n.* (ADW 29663, CANB 209778). *Rohrlach* 53 (AD, G, K). *Smith* 120 (MEL). *Specht* 43, 2024, 2025, 2026, 2393 (AD); *s.n.* (AD 97331292). *Spooner* 2501, 2391 (AD). *Symon* 943 (ADW); 8105B (AD, ADW). *Tepper* 114, 150 (MEL); 598 (AD, MEL); 600, 633, 776 (MEL). *Weber* 3746 (AD, HO, NT); 3748 (AD); 4006 (AD, CANB, MEL); 4076 (AD); 4200 (A, AD, B, Z); 4245, 4300 (AD); 4413 (AD, BM); 4414 (AD). *Wheeler* 594 (AD, SI, W). *Whibley* 5761 (AD, CANB). *Wilhelmi s.n.* (MEL 58534). *Wilson* 2672 (AD).

8b. *Cassytha peninsularis* var. *flindersii* J.Z. Weber, var. nov.

Caulis 0.5-1.6 mm crassus. *Folia* angulato-ovata, obtusa, (1.5-) 3-4 x 0.4-1 mm, viridia. *Flores* c. 2 x 1.5 mm, virides primitus, demum flavi; floris bractaea virides primitus, demum bruno-coriaceae. *Stamina* ordinis primi c. 1.5 x c. 1 mm, cruciata; staminodia et glandulae eglanulatae. *Gynoecium* glabrum. *Fructus* obovoidei, 7-9 x 5-6 mm, glabriusculi, virides vel rufo-flavidi, exsiccati denigrati.

Type: J.Z. Weber 3682, southern slopes of Mt Remarkable (32° 49' S; 138° 10' E), 6.xii.1973 (AD 97338070, holo.; BRI, CANB, G, HO, K, MEL, NSW, NY, OXF, PERTH, iso.).

Stem 0.5-1.6 mm thick, green to green-red. *Leaves* angular-ovate, obtuse, (1.5-) 3-4 x 0.4-1 mm, green. *Haustoria* oval, c. 1 mm long. Bract supporting inflorescence triangular-ovate, 1-1.5 x c. 1 mm, brown, leathery; bracteoles similar, smaller, 0.8-1.3 x c. 0.9 mm. *Flowers* c. 2 x 1.5 mm, first green, later yellow. Floral bract triangular, obtuse, c. 1.5 x 1 mm, fleshy, peltate, green, turning later brown, leathery; bracteoles ovate, 1-1.2 x c. 1 mm, slightly pubescent, ciliate, green, turning leathery. *Sepals* triangular-ovate, c. 1 x 1 mm, green, fleshy, sometimes pubescent with white hairs; *petals* triangular-ovate, subacute-obtuse, c. 1.5 x 1.5 mm, fleshy, first greenish, later yellowish on margins, slightly pubescent outside, densely pubescent inside mostly basally. *Stamens* first greenish, turning white

like the staminodes and glands; stamens of the first whorl cruciform, c. 1.5 x 1 mm; filament narrowing basally, sometimes pubescent dorsally; stamens of the second whorl c. 1 x 0.5 mm; stamens of the third whorl c. 1 x 0.5 mm, filament apically expanded into a small beak. Staminodes obcordate, acute, 0.6 x 0.5 mm, without white apical gland; glands ovate, c. 0.4 x 0.3 mm, not white tipped. Ovary c. 1.1 x 0.5 mm, glabrous. Fruit obovoid, 7-9 x 5-6 mm, glabrescent with few scattered white hairs, slightly six-ribbed, pale-green to yellow and red spots, drying black; glandular ring well developed, especially on young fruits and conspicuous on dried specimens, stone c. 4 x 3.5 mm, black. (Fig. 15.)

Distribution (Map 8)

Endemic to South Australia in the Flinders Ranges from Mt Playford and the Freeling Heights southwards to Mt Remarkable and Mambray Creek. Confined to mountains and usually to higher altitudes.

Flowering

Flowering from April-December, the fruits developing in 6-8 weeks.

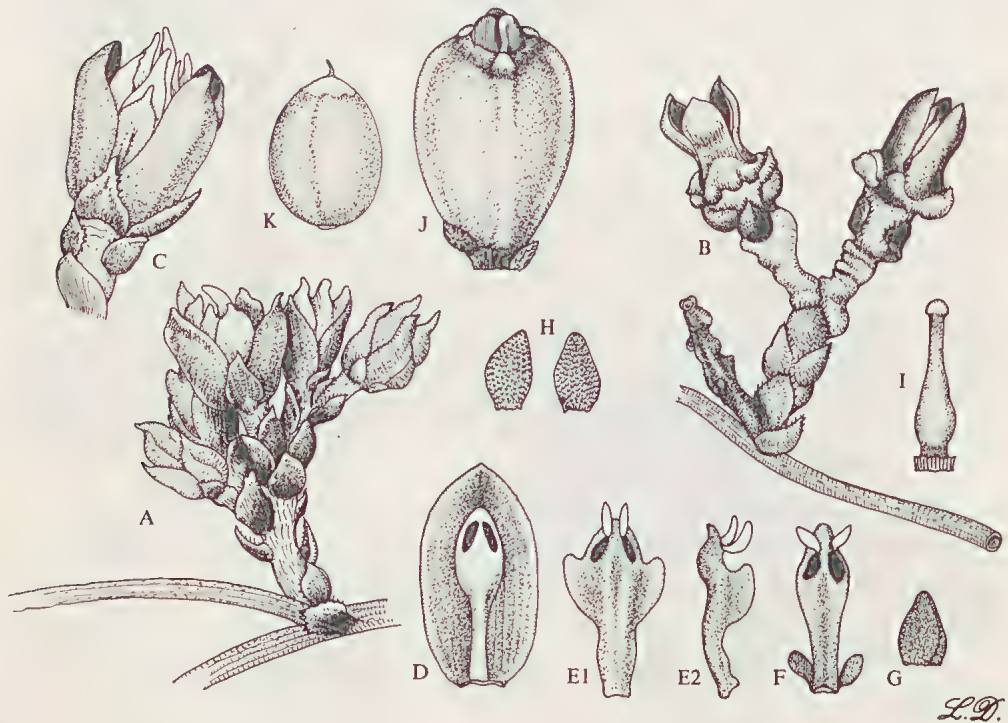


Fig. 15. *Cassytha peninsularis* var. *flindersii*. A, stem and inflorescence with flowers. B, young fruits, with pedicels attached to the peduncle, showing stressed glandular ring at the base of the petals; lower barren peduncle showing scars of fallen fruits. C, flower, showing pedicel with basal bract and remote higher bracteoles subtending flower, stamens protruding between petals. D, petal, from inside, showing dorsi-basally attached stamen from the second whorl. E, stamens of the first whorl, showing laterally expanded filament and upright flap: E1, front view, showing open loculi; E2, side view. F, stamen of the third whorl, showing open loculi and upright flap; two glands are attached basally. G, staminode. H, glands, centripetal view. I, ovary. J, fruit, showing bract at the base of the pedicel and remote higher bracteoles flanking fruit; apically faint glandular ring at the base of the perianth which closes the orifice. K, stone.

Similarities

This variety differs from var. *peninsularis* in the young flowers being greenish, staminodes and glands not white-glandular tipped, the glabrous ovary and usually glabrous fruit. The fruit in an early stage is obconical with a prominent glandular rim and almost glabrous; when fully developed it is obovate (sometimes obconical) with only a few sprinkled hairs, drying black. In var. *peninsularis* the fruit in all stages has a spherical base, is pubescent and is clearly marked even from the early stage with 6 red and white vertical stripes. *C. peninsularis* var. *flindersii* resembles *C. nodiflora* in having a glomerulate inflorescence and glabrescent fruit drying black, but differs in having bracts in two planes, staminodes and glands white-tipped, obovate fruits generally larger and with a glandular rim on top while the fruits of *C. nodiflora* are quite sessile, globose and without a glandular rim on top. This variety has similarities with *C. pubescens* from the Mt Lofty Ranges in South Australia in having yellow flowers and short peduncles and the fruit drying black, but differs in not having heavily pubescent petals and fruit nor floral bracts verticillate.

Specimens examined

SOUTH AUSTRALIA: Bates 234, 480 (AD); s.n. (AD 97623143-6, 97623148-9, 97623151, CANB, PERTH). Cooper s.n. (AD 96509235). Donner 4207 (AD); 4911 (AD, BRI); 5026 (AD, MEL, PERTH). Hill 1547 (AD, HO). Hornsby s.n. (AD 97807177, BRI, CANB, M). Kuchel 3085 (AD). Lothian 3150, 5280 (AD). Mueller s.n. (MEL 58485). Weber 3665 (AD, G, K, NY, TCD); 4716 (AD, CANB, FI). Whibley 4245 (AD, P); 4358 (AD, HAL, LY).

9. *Cassyltha nodiflora* Meisn. in DC., Prod. 15: 252 (1864); Benth., Fl. Aust. 5: 309 (1870); Muell., Sec. Census Aust. Pl. 7 (1889); Gardner, Enum. Pl. Austral. Occ. 44 (1931); Blackall, How to Know Western Austral. Pl. 1: 168 (1959).

Type: *J. Drummond* Coll. no. 226, "Swan River Colony", (Western Australia), anno 1848 (K, lecto. (nominated here), BM, G, MEL/52333, NSW, NY, TCD, isolecto.; *J. Drummond* Coll. no. 228, "Swan River Colony", (Western Australia), anno 1848 (BM-2 sheets, G, K, MEL/58499, TCD, syn.).

Stem (0.4-) 0.8-0.9 (-1.5) mm thick, glabrescent, yellow-green, green-brown (dried), young shoots white-pubescent with retrorse hairs. *Leaves* ovate, c. 1 x 0.5 mm, acute, pubescent to glabrescent, ciliate, peltate, often with gland centrally and hair tufts basally, drying darker, leathery. *Haustoria* oval, c. 1 mm long. *Inflorescence* a single or fasciculate, spike or short panicle, flowers in crowded glomerules, 3-20 (rarely more) flowered. Peduncles 1-3 x c. 1 mm, grey-pubescent turning brown. Supporting bract ovate, c. 2 x 1 mm, peltate, glabrous, ciliate or with hyaline margin, green turning brown; bracteoles similar or triangular, c. 1 x 0.5 mm, basifixed, at each division of peduncle a similar set of bracts. *Flowers* first ovoid, later obovoid, 1.3-2.7 x 1.4-2 mm, sessile, first greenish, later yellow. Floral bracts verticillate; bract ovate, subacute, c. 1.5 x 1 mm, more or less basifixed, glabrescent, ciliate or with a more or less hyaline margin, yellow-green turning brown, occasionally with central gland; bracteoles similar, c. 1 x 1 mm, basifixed, glandless. *Sepals* ovate, c. 1.2 x 1.2 mm, glabrous (rarely sprinkled with a few hairs), green-yellow maturing yellow, on fruits brown and leathery; *petals* ovate, obtuse, 1.2-2.5 x 1-2 mm, glabrous outside, pubescent inside, yellow when mature, in fruit brown and leathery. Fertile *stamens* 9, firstly white; staminodes and glands turning brown; stamens of the first whorl angular-ovate to cruciform, 1.3-1.9 x 0.6-1 mm, below cells filaments produced laterally into 2 distinct lobes, wider than cells or into a pair of lateral mucros, puberulent on back, ciliate; stamens of the second whorl oblanceolate, c. 1.2 x 0.5 mm, cells wider than filament; stamens of the third whorl angular-obovate, c. 1.3 x 0.4 mm, cells wider than filament, bulging over staminodes and glands. Staminodes pyramidal, c. 0.6 x 0.4 mm, with distinct white glandular tip; glands ovoid, c. 0.5 x 0.3 mm, with distinct white glandular tip. *Ovary* filiform, c. 1.3 x 0.4 mm, glabrous. Receptacular

tube pubescent inside. *Fruit* globular, 5-7 x 4-6 mm, glabrous, green to yellowish-green, sometimes with yellow-reddish stripes, drying black; stone globular, c. 3.5 x 3 mm, black. (Fig. 16.)

Flowering

Flowering specimens have been found from Aug.-Jan., fruits in Sept. and Oct.

Distribution (Map 9)

Endemic to the south-west of Western Australia, from Shark Bay in the south-south-east, east of Geraldton, Morawa, Southern Cross and eastwards to Norseman, preferring sandy flats.

Notes

The two Drummond collections cited by Meisner are conspecific and both agree with the type description. Meisner annotated K and NY specimens and cited, but did not annotate specimens in G. Of these *Drummond 226* (K) is the most complete and is therefore selected as the lectotype.

Specimens examined

WESTERN AUSTRALIA: *Beaglehole* 1944 (BEAUGLEHOLE); 49383 (AD, BEAUGLEHOLE). *Chinnock* 3101 (AD, W, Z); 3142 (AD, UPS); 3161 (AD, UC, UW); 3331 (AD, TRN); 3771 (AD, OSH). *Donner* 4597 (AD, L, MTJB); 4656 (AD, H). *Haegi* 1120 (AD, G, GOET). *Koch* 3013 (MEL, NSW). *Munir* 5270 (AD, K, NY). *Weber* 5036 (AD, AK, BISH, CHR); 5039 (AD, HAL); 5050 (AD, LY); 5109 (AD, P); 5113 (AD, OXF); 5142 (AD, BM); 5145 (AD, TCD); 5150 (AD, NY); 5202 (AD, HBG); 5206 (AD, M); 5217 (AD, K); 5226 (AD, NSW); 5227 (AD, PERTH). *Whibley* 4592 (AD, PERTH); 4722 (AD, CANB, PERTH). *Young s.n.* (MEL 50500).

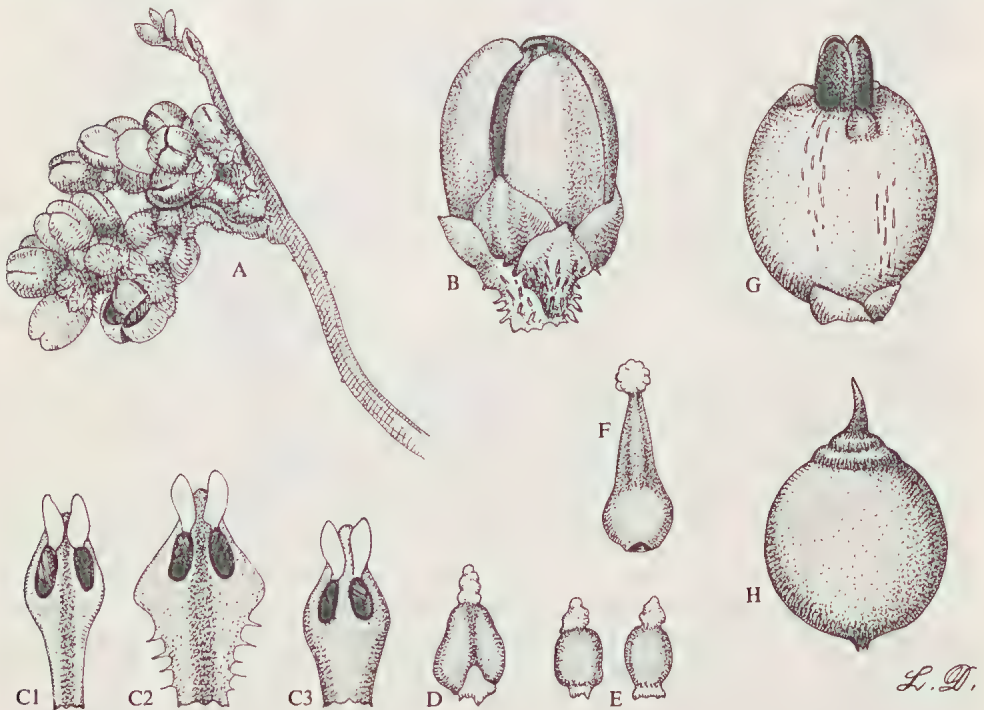


Fig. 16. *Cassytha nodiflora*. A, stem with young shoot and inflorescence with flowers. B, flower with bracts. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally expanded filament with cilia; C3, third whorl. D, staminode with white apical gland. E, glands with white apical gland(s). F, ovary. G, fruit, showing bracts and perianth with closed orifice. H, stone.

10. *Cassytha aurea* J.Z. Weber, sp. nov.

Planta tote pubescentia. *Caulis* 0.5-2.2 mm crassus, ramosissimus, cano-viridis, rubro-viridis ad fuscem, pubescens, obsolete striatus (in sicco); *haustoria* elliptica, 1-3 mm longa. *Folia* squamiformia, ovata vel triangularia, 1-2 x 0.5-1 mm, pubescentia, fusca. *Inflorescentia* solitaria, bina, fasciculata vel paniculata; pedunculi 3-30 (raro -110) mm longi, cano- ad flavo-pubescentes, floribus 2-10. Floris bracteae verticillatae; bracteae triangulares, acutae, fuscae. *Flores* ovati, 1-3 x 1-2.2 mm, cano-virides ad aureo-virides, cano-pubescentes; *sepala* triangulatio-ovata, 1-1.5 x c. 1 mm, flavo-viridia ad pallido-brunnea, cano-pubescentia; *petala* ovata vel obovata, 0.8-2.5 x 1-1.6 mm, luteo-viridia ad cano-viridia, albo-pubescentia. *Stamina* fertilia 9; stamina ordinis primi angulato-ovata, obtusa, 1-2 x 0.6-1 mm, filo expanso, saepe pubescenti vel ciliati; stamina ordinis secundi lanceolata, obtusa, 1-1.5 x c. 0.5 mm, filamentis saepe ciliolatis; stamina ordinis (3) intima angulato-lanceolata, vel rhombica, 0.8-1.8 x c. 0.6 mm; staminodia obcordata vel pyramidata, apicibus saepe albo-glanduliferis vel apicibus fuscis; glandula angulato-ovata vel ovata, saepe dorso-ventraliter adpressa et apicibus albo-glanduliferis vel fuscis. *Fructus* globosus, 8-10 mm transversus, cano-viridis, cano-lanato-pubescentis vel glaber.

Type: J.Z. Weber 4896, c. 25 km west of Giralia Homestead in creek bed along the track to Gales by (22° 39' S; 114° 08' E), 2.x.1975 (AD, holo.; CANB, K, MEL, NSW, NY, PERTH, iso.).

Stem (0.5-) 1 (-2.2) mm thick, pubescent to glabrescent, grey-green, yellow-green to brown. Young shoots woolly pubescent, often reddish. *Leaves* ovate to triangular, more or less acute, 1-2 x 0.5-1 mm, pubescent brown. *Inflorescence* a panicle or of single, paired or fasciculate loose or congested heads or spikes, peduncles 3-30 (-110) x 0.7-2 mm, usually woolly pubescent, hairs curly, yellow or grey. Supporting bract triangular or angular-ovate, more or less acute, 0.5-1.5 x 0.5-1 mm, pubescent, brown; bracteoles triangular, 0.4-3 x 0.4-2.5 mm, pubescent. *Flower* mostly ovate, sessile, 1-3 x 1-2.2 mm, grey-green or yellow-green, heavily pubescent. Floral bracts verticillate; bract triangular, acute, 1-2.5 x 0.8-2 mm, white pubescent outside, glabrous inside, light brown; bracteoles similar, smaller, 0.8-1.5 x 0.8-1 mm. *Sepals* triangular-ovate, 1-1.5 x c. 1 mm, yellow-green to light-brown, pubescent outside, glabrous inside. *Petals* ovate or obovate, subacute, 0.8-2.5 x 1-1.6 mm, white, yellow-green to grey-green, pubescent on both sides with \pm antrorse hairs, in fruit erect or rotate. Fertile *stamens* 9, white or light brown, turning brown; stamens of the first whorl angular-ovate or obovate, widest below cells, 1-2 x 0.7-1 mm, tip obtuse, filament laterally expanded, basally narrowed, mostly pubescent or ciliate; stamens of the second whorl oblanceolate, widest at the level of the cells, 1-1.5 x c. 0.5 mm, cells obcordate, tip obtuse, filament narrow, mostly pubescent or ciliate; stamens of the third whorl narrow-rhomboid, widest at or below the cells, 0.8-1.8 x 0.5-6 mm, cells narrow-obcordate, bulging over staminodes and glands. Staminodes obcordate or narrow-pyramidal, 0.7-1 x 0.4-0.5 mm, shortly stalked, light brown and with white apical glands, or white and without glands but sometimes dark tipped; basal glands angular-ovate, 0.4-1 x 0.4-0.5 mm, either brown, squarish with white apices, when white ovoid and sometimes with darker pointed tips. *Ovary* fusiform, 2-2.5 x c. 0.7 mm, mostly pubescent. Receptacular tube pubescent or glabrous inside. *Fruit* globular, 8-10 mm across, grey-green or yellow-green, heavily pubescent, sometimes long hairs in white and brown stripes, drying grey-black or brown. *Stone* globular, brown, 4-6 mm across. (Figs 17-19.)

Distribution (Map 10)

Endemic to Western Australia and Northern Territory, mostly-coastal.

Flowering

Flowers apparently all year round.

Notes

On some specimens the glandular rim on the top of the fruit is well developed, but in the mature fruit it is overgrown by hairs and less conspicuous.

Key to Varieties

1. Ovary glabrous; fruit glabrous; stamens of the first whorl narrow-rhomboid, $\frac{1}{2}$ as wide as long (northern var.) 10b. var. *candida*
 Ovary pubescent; fruit pubescent; stamens of the first whorl ovate, $\frac{2}{3}$ as wide as long (south-western vars) 2
2. Flowers in loose head; staminodes and glands white tipped 10a. var. *aurea*
 Flowers in congested head; staminodes and glands not white tipped 10c. var. *hirta*

10a. *Cassytha aurea* var. *aurea*

Vernacular Name

“Tangle foot”.

Stem (0.7-) 1 (-2.2) mm thick, reddish-green to brown, young shoots mostly woolly-white pubescent. *Leaves* ovate, c. 2 x c. 1 mm, above with dense indumentum of curly hairs, below bristles in tufts. *Inflorescence* various; peduncles 3-30 (rarely -80) mm long, supporting bract triangular, c. 1 x 1 mm; bracteoles similar, smaller. *Flowers* 2.5-3 x 1.5-2.2 mm in loose head, one or two remote below. Floral bract c. 1 x 0.8 mm; bracteoles similar, c. 0.8 mm long. *Sepals* c. 1 x c. 1 mm, grey-pubescent; *petals* ovate, c. 2.5 x 1.6 mm, hairs mostly straight, grey and tinted red. *Stamens* light-brown; stamens of the first whorl rhomboidal-ovate, c. 2 x c. 1 mm, ciliate mostly in lower half; stamens of the second whorl c. 1.5 x 0.5 mm, ciliate in lower half; stamens of the third whorl angular-lanceolate, c. 1.8 x c. 0.6 mm. *Staminodes* obcordate, c. 0.8 x 0.5 mm, light-brown,

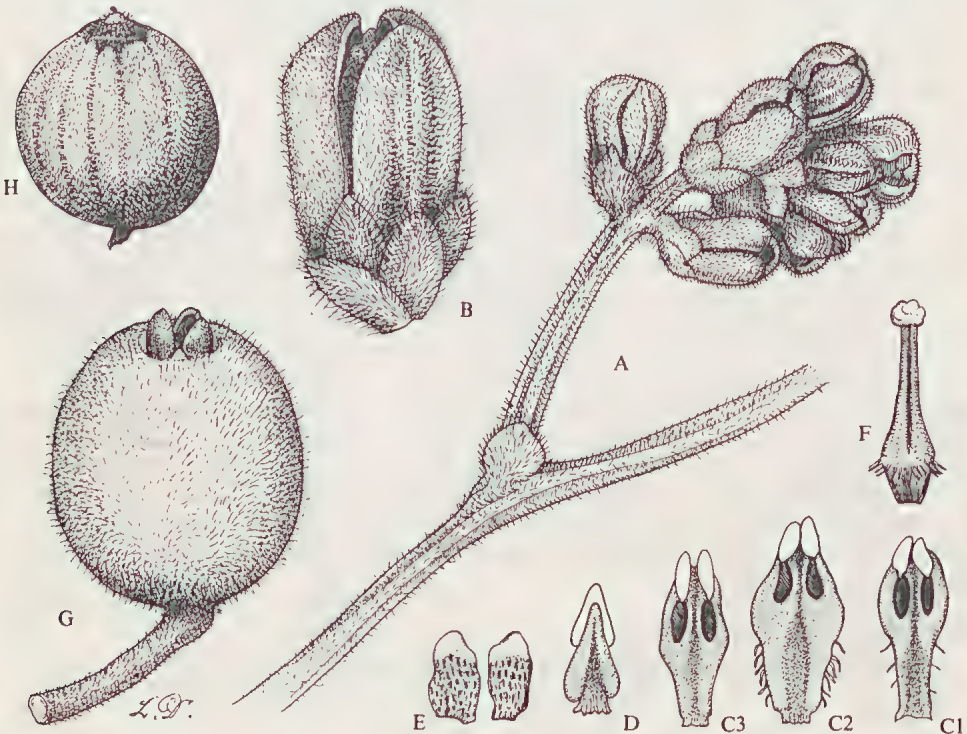


Fig. 17. *Cassytha aurea* var. *aurea*. A, stem and inflorescence with flowers. B, flower with two bracts showing pubescence. C, stamens, front view showing open loculi with upright flaps: C1, second whorl showing with cilia on filament; C2, first whorl, showing laterally widened filament with cilia; C3, third whorl. D, staminode, centripetal view showing white apical gland. E, glands, centripetal view showing white apical gland(s). F, ovary showing median hairs. G, fruit on peduncle showing perianth and indumentum. H, stone.

glandular white tipped; glands angular-ovate, c. 0.7 x 0.5 mm, light-brown, with white apex. *Ovary* with ring of hairs medially. Receptacular tube pubescent inside. *Fruit* grey-green, pubescent, with glandular ring on top (not conspicuous). (Fig. 17.)

Distribution (Map 10)

Endemic to Western Australia in coastal regions from North West Cape southwards to Geraldton.

Flowering

Flowering specimens were collected from August to November, fruiting specimens from June to December.

Similarities

This variety shows similarities with *C. melantha* in the robust stem and loose inflorescence, but differs mainly in having yellow flowers with white indumentum which is antrorse on the petals, pubescent ovary and heavily pubescent fruit.

It differs from var. *candida* and var. *hirta* in having staminodes and glands white tipped.

Specimens examined

WESTERN AUSTRALIA: *Barker 2141* (AD, AK, BISH, CHR); 2239 (AD, DELHI). *Beaglehole 12048* (BEAUGLEHOLE). *Carriage 110* (CANB). *Chadwick 1389* (PERTH). *Chinnock 3167* (AD, FRI, G); 3188 (AD, GOET, H); 3809 (AD, MTJB). *Drummond 10* (MEL). *Jackson 3149* (AD, OSH, TRN). *Mueller s.n.* (MEL 58688). *MacFarland s.n.* (AD 97722485, M, P). *George 1286, 6558* (PERTH). *Gribble 27* (MEL). *Oldfield s.n.* (MEL 58556, 58750). *Reader s.n.* (MEL 58571). *Royce s.n.* (PERTH). *Weber 4898* (AD, CANB, M); 4908 (AD, NT); 4909 (AD, BRI); 4931 (AD, HO); 4932 (AD, HBG); 4935 (AD, TCD); 4990 (AD, BM); 5011 (AD, G); 5113 (AD, OXF); 5016 (AD, LY); 5023 (AD, HAL); 5035 (AD, PERTH); 5038 (AD, LJU).

10b. *Cassytha aurea* var. *candida* J.Z. Weber, var. nov.

Caules 0.5-1.8 mm crassi, albo-pubescentes; *folia* triangularia, pubescentia. *Pedunculi* 10-110 mm longi, albo-pubescentes, floribus 10-15 vel plus. *Flores* in capitulis elongatis congestis; floris bracteae in planitie una; *sepala* triangularia, albo-pubescentia; *petala* ovata, subacuta, dense albo-pubescentia, antrorsa. *Stamina* oridinis primi angustiora, angulato-lanceolata, 0.7-0.8 mm lata. *Fructus* subglobosus, c. 8 mm latus, fusco-viridis.

Type: A. C. *Beaglehole 52710*, Meda-Oobagooma Road, c. 65 km N. of Gibb River Road, (16° 53' S; 123° 58' E), 12.vi.1976 (AD, holo; Herb. BEAUGLEHOLE 2 sheets, iso.).

Stem (0.5-) 0.7 (-1.8) mm thick, white-pubescent, rarely glabrescent, yellow-green, rarely grey-green or brown-green (dried). *Haustoria* to 1 mm long. Young shoots heavily white-pubescent, *leaves* triangular, acute, c. 1 x 0.5 mm, white-pubescent, green to brown. *Inflorescence* single, appearing indefinite, densely white-pubescent, peduncles (10-) 20-30 (-110) x 0.7-0.9 mm (dried), 10-15 or more flowered. Subtending bract triangular, acute, 0.5-1.5 x 0.5-1 mm, pubescent, brown, bracteoles similar, smaller. *Flowers* globular, ovate to obovate, 1-2.1 x 1-1.6 mm (dried) dull white-pubescent, crowded in the elongated head. Floral bracts in one plane; bract c. 1.2 x 1 mm, pubescent, ciliate; bracteoles similar. Receptacular tube glabrous. *Sepals* triangular, c. 1 x 1 mm, yellow-brown. *Petals* ovate, 0.8-2 x c. 1 mm, densely pubescent with rigid dull white antrorse hairs, less pubescent inside. *Stamens* glabrous, white; stamens of the first whorl angular-lanceolate, usually twice as long as wide, 1-1.8 x 0.7-0.8 mm, cells nearly parallel, expanded filament pointed; stamens of the second whorl lanceolate, 1-1.5 x 0.5 mm, filaments apically enlarged; stamens of the third whorl lanceolate, acute, 0.8-1 x 0.5-0.6 mm, cells obcordate, widest; staminodes narrow pyramidal, acute, c. 0.7 x 0.4 mm, white, turning brown; glands ovate, trilobed, obtuse, c. 0.4 x 0.4 mm, white, turning brown. *Ovary* obpyriform with slender style, glabrous; receptacular tube pubescent inside. *Fruit* glabrescent, sprinkled with few hairs, c. 8 x 8 mm, green with vertical

blotches, drying brown, corky; turning black if dried before ripening. Stone globular, c. 4.5 x 4 mm, brown. (Fig. 18.)

Distribution (Map 10)

Mainly a coastal plant, found in the tropics of Western Australia in the Kimberleys and in Northern Territory in Arnhem Land.

Flowering

Flowering and fruiting simultaneously, probably all year round.

Similarities

This variety shows similarity with *C. rufa*, less with *C. melantha* in the long peduncle to -110 mm, which continues growth while flowering and fruiting. It differs from them in having flowers at first in a condensed elongated head, later in having brown corky (smooth in unripe) fruits. The narrow stamens of the second whorl are quite similar to those of *C. melantha*, but in *C. rufa* they are wider. It differs from var. *aurea* and var. *hirta* in the glabrous stamens and ovary, and in the glabrescent fruit which is sprinkled with hairs as in *C. melantha*.

Specimens examined

WESTERN AUSTRALIA: Basedow 123 (NSW). Wilson 11290, 11527 (PERTH).

NORTHERN TERRITORY: Martensz & Schodde AE702 (BRI, CANB, DNA, NT). Parker 117 (BRI).

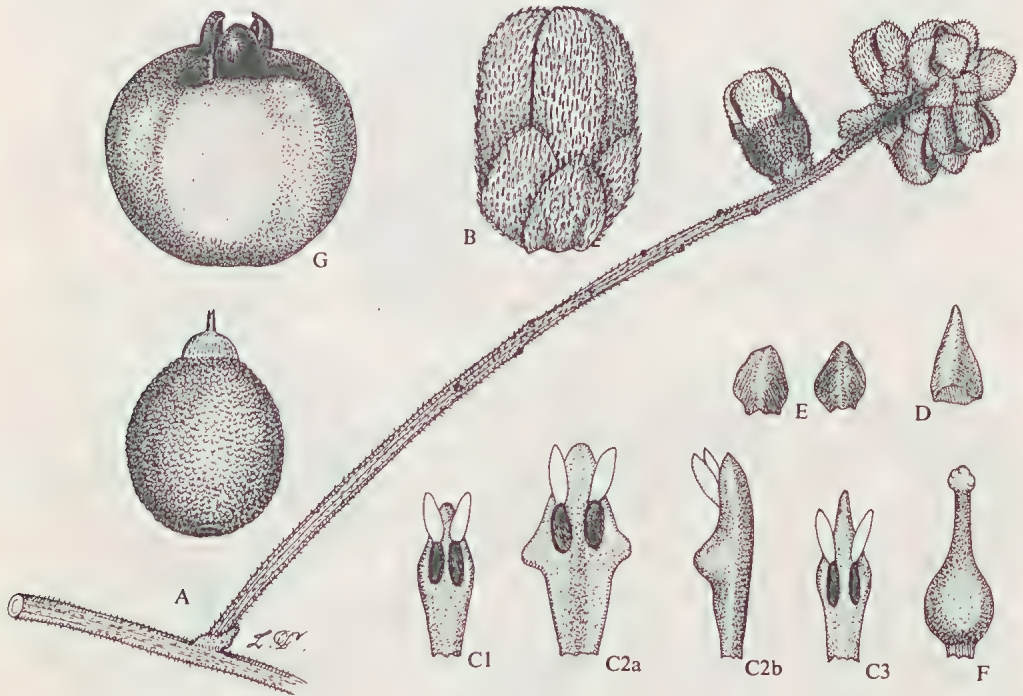


Fig. 18. *Cassytha aurea* var. *candida*. A, stem and inflorescence showing flowers and young fruit. B, flower with bract showing hairs. C, stamens, showing open loculi and upright flaps: C1, front view of second whorl; C2, first whorl, showing laterally expanded filament (a, front view; b, side view); C3, front view of third whorl. D, staminode. E, glands. F, ovary. G, fruit, showing perianth with open orifice.

10c. *Cassystha aurea* var. *hirta* J.Z. Weber, var. nov.

A var. *aurea* differt inflorescentia densa in capitulo hirta staminidiis et glandulis apicaliter fusco-acutiusculis.

Type: J.Z. Weber 5106, c. 31 km east of Geraldton along the road to Mullewa, 15.x.1975 (AD, holo.; CANB, NSW, PERTH, iso.).

Stem (0.6) 1 (-2) mm thick, yellow-green to grey-green, woolly-pubescent to glabrescent, hairs white and tinted black; young shoots often reddish; scaly leaves triangular, c. 1.5 x 1 mm. Inflorescences commonly paired, sometimes fasciculate and paniculate, in young stage often reddish, later grey and quite persistent after the fruit is shed. Peduncles 5-10 mm long, bearing flowers distally condensed in a hairy head. Supporting bract angular-ovate, peltate, c. 1.5 x c. 1 mm, brown, leathery; bracteoles ovate, 1-3 x 1-2.5 mm brown, leathery, one or two carried higher on the peduncle remote from bract. Flowers 2-2.5 x 1.5-2 mm, yellowish. Floral bract c. 2.5 x 2 mm, pubescent with long white and mixed black hairs; bracteoles triangular to lanceolate, c. 1.5 x 0.8-1 mm, indumentum white and grey. Sepals ovate, acute, c. 1.5 x c. 1 mm, apical hairs tinted black; petals obovate, yellowish, 2-2.5 x 1.5-1.7 mm, white-pubescent. Stamens staminodes, glands and ovary white; stamens of the first whorl angular-ovate, c. 2 x 0.9 mm, pubescent on the back; stamens of the second whorl fusiform, c. 1.9 x 0.6 mm; stamens of the third whorl angular-fusiform, c. 1.8 x 0.7 mm, cells widest, bulging.

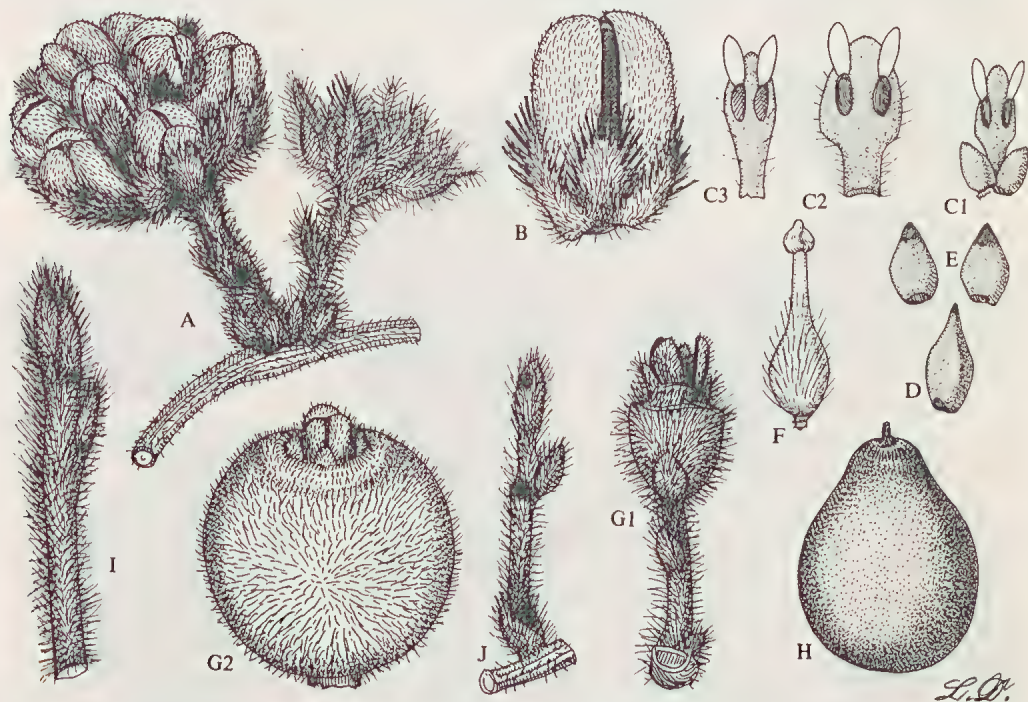


Fig. 19. *Cassystha aurea* var. *hirta*. A, stem with paired inflorescences, immature on right, in flower on left. B, flower with two bracts showing hairs. C, stamens, front view showing open loculi and upright flaps: C1, second whorl, showing hairs on the filament; C2, first whorl, showing laterally expanded filament with hairs; C3, third whorl with basal glands. D, staminode with dark pointed tip. E, glands with dark pointed tip(s). F, ovary and lower style, showing hairs. G, fruits, showing pubescence: G1, young fruit on the peduncle supported by bract, showing terminal glandular ring and perianth; G2, mature fruit, showing faint glandular ring around perianth. H, stone. I, young shoot, showing scale leaves attached basally. J, pubescent peduncle, showing scars of fallen fruits.

Staminodes triangular, pointed, c. 1 x 0.4 mm with slightly dark tip which turns darker; glands ovate, c. 0.7 x 0.4 mm, slightly pointed, with darker tip. *Ovary* slightly angular, pubescent in upper half. Receptacular tube pubescent inside. Ripe *fruit* yellow-green. (Fig. 19.)

Distribution (Map 10)

Endemic to south-western Western Australia from Geraldton southwards to Perth, Tammin and Lake Wagin, which is the furthest point from the coastline.

Flowering

Flowering specimens were collected between August-November, with fruits all the year round.

Notes

It appears that var. *hirta* is a southern extension of *C. aurea* changing around Geraldton from var. *aurea* to var. *hirta*, where both variants were collected, but the intergradation was not observed.

Similarities

This variety shows similarities with var. *aurea* in stamens and fruit, with var. *candida* in the staminodes and glands not being white-tipped but with the tip being darker pointed, from both varieties in having the supporting bracteoles on the peduncle higher, remote from the bract which is at the base, and having flowers in quite condensed, grey-pubescent heads.

Specimens examined

WESTERN AUSTRALIA: *Blackall 4526* (PERTH). *Burbidge 2039* (CANB). *Cronin s.n.* (MEL 62372). *Eaton s.n.* (MEL 58716). *Fitzgerald s.n.* (NSW 135036). *Gardner 8568* (PERTH). *Kenneally 1283* (PERTH). *McFarland 1296* (AD, M, P). *Meebold 6622, 10070* (M). *Wilson 6662* (PERTH).

11. *Cassytha rufa* J.Z. Weber, sp. nov.

Caulis 0.5-1.5 mm crassus, pubescens vel glabriusculus. *Folia* triangularia, pubescentia. *Pedunculi* 15-30 (-220) mm longi, rufi, floribus 7-8 vel plus. *Flores* primitus in capitulo laxo, demum remote multiflori et acropetaliter maturescentes; floris bractea verticillatae. *Flores* ovoidei, 1.7-2.3 x 1.2-1.7 mm, pubescentes; *sepala* triangularia, c. 0.8 x 0.7 mm, pubescentia; *petala* ovata, subacuta, 1.5-2.1 x 1.3-1.5 mm, pubescentia rufa vel alba antrorsa. *Stamina* fertilia 9; *stamina* ordinis primi cruciata, c. 1.6 mm lata; *stamina* ordinis secundi c. 0.4 mm lata, filamentis saepe acutiusculis; *stamina* ordinis tertii oblanceolata, c. 0.4 mm lata. *Fructus* globosus, c. 7 x 5.5 mm (in sicco), papillosus, bruneus.

Type: *C.H. Gittins 1015*, Kennedy Road, c. 3 km N of Pascoe River (12° 45' S; 143° 05' E), Aug. 1965 (BRI 085582, holo.; NSW, iso.).

Stem (0.4-) 0.7-0.8 (-1.5) mm thick, pubescent to glabrescent, indumentum white or red or green-grey to brown (dried). Young shoots densely tomentose with retrorse hairs. *Haustoria* elliptical, c. 1 mm long. *Leaves* triangular, basifixed, c. 1.3 x 0.5 mm, pubescent to glabrescent, ciliate, honey-brown, turning brown to black. *Inflorescences* indefinite, single or rarely paired or fasciculate, peduncles (12-) 20-30 (-220) x 0.7 (-1) mm, usually rusty coloured, red and white pubescent to puberulent, (2-) 7-8 (-16 or many) flowered. *Flowers* at first in a loose head, later remote along the lengthening peduncle and the fruits ripening acropetally, often with fruits basally and few congested flowers in buds terminating. Bract supporting peduncle triangular, acute, c. 1.5 x 1 mm, more or less pubescent and ciliate; bracteoles similar, smaller, c. 1 mm long, sometimes one carried apart higher up on the peduncle. *Flowers* ovoid, 1.7-2.3 x 1.2-1.7 mm, pubescent yellowish. *Floral bracts* verticillate; bract triangular, acute, c. 1 x 0.7 mm, red-pubescent, ciliate; bracteoles similar, smaller, c. 0.8 mm long. Receptacular tube short, red or white pubescent. *Sepals* triangular, subacute, c. 0.8 x 0.7 mm, red pubescent, ciliate. *Petals* ovate, subacute, 1.5-2.1 x 1.3-1.5 mm, pubescent on both sides; hairs short, appressed,

antrorse, red and white, margins with darker glabrous rim (dried). Fertile *stamens* 9; stamens of the first whorl ovate, c. 1.2 x 1.6 mm, filament widely expanded, wider than cells, laterally pointed, base narrower; stamens of the second whorl oblanceolate, c. 0.8 x 0.4 mm, filament narrower than cells; stamens of the third whorl oblanceolate, c. 1.2 x 0.4 mm, cells obcordate, wider than filament. *Staminodes* obcordate, c. 0.6 x 0.5 mm, glands ovate, c. 0.4 x 0.3 mm. *Ovary* glabrous. Receptacular tube pubescent inside. *Fruit* globular, c. 7 x 5.5 mm (dried), puberulent, papillose, drying brown, rarely black. *Stone* globular, c. 4.5 x 4 mm. (Fig. 20.)

Distribution (Map 11)

Endemic in Queensland, in Cape York Peninsula from Iron Range southwards, Mt Mulligan, westwards Prairie and south to Cunnamulla.

Flowering

Flowers probably all year round.

Notes

Specimens in flower have shorter peduncles than those in fruit in which peduncles apparently continue to grow in length, (-220 mm; *Brass 19103*), showing scars of fallen fruits and bearing fruits, flowers and flowerbuds terminally, the thick peduncle resembling the stem.

Similarities

This species shows similarities with *C. melantha* and *C. pubescens* in the prolonged inflorescence with remote flowers and fruits, but *C. melantha* has stouter stems and larger flowers, with black retrorse hairs on the petals; from *C. pubescens* it differs in always having sessile flowers and papillose brownish fruits.

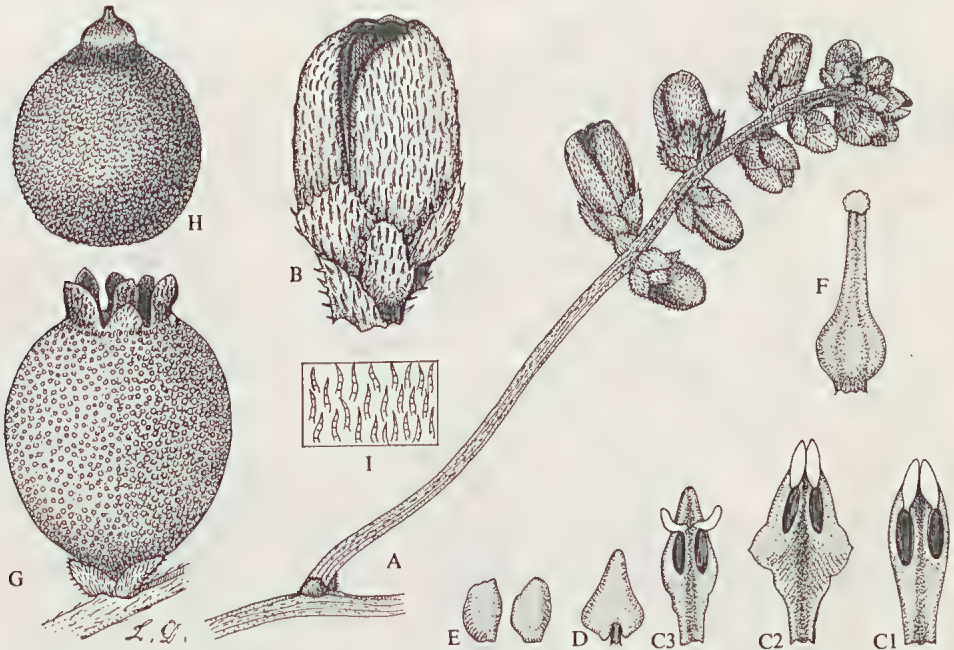


Fig. 20. *Cassytha rufa*. A, stem and inflorescence with flowers. B, flower, showing bracts and hairs. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally expanded filament; C3, third whorl. D, staminode, centripetal view. E, glands. F, ovary. G, fruit, showing verticillate basal bracts and rotile perianth. H, stone. I, hairs, enlarged, on petals.

Specimens examined

QUEENSLAND: *Allen 496* (CANB). *Brass 19103* (CANB, G); *19632* (CANB). *Chisholm s.n.* (Herb. Lon(K)). *Clemens s.n.* (BRI 177503, G, K, NY). *Flecker s.n.* (BRI 177829). *Jones 1878* (CANB). *White 8935* (BRI, NY).

12. *Cassytha melantha* R. Br., *Prod. Fl. Nov. Holl.* 404 (1810); Sprengel, *Syst. Veg.* 2: 271 (1825); Nees, *Syst. Laur.* 647 (1836); Hook. f., *Fl. Tasm.* 1(4): 317 (1857); Meisner in DC., *Prod. Syst. Nat. Regni Veg.* 15: 254 (1864); Benth., *Fl. Austral.* 5: 311 (1870); Spicer, *Handb. Pl. Tasmania* 130 (1878); F. Muell., *Fragm.* 5: 167 (1866); Tate, *Trans. R. Soc. S. Aust.* 6: 95 & 149 (1883); F. Muell., *Key Syst. Vict. Plant.* 125 (1887-1888); F. Muell., *Sec. Syst. Census Austral. Plant.* 7 (1889); F. Muell., *Native Pl. Victoria* 24 (1889); Tate, *Handb. Fl. Extratrop. South Australia* 205 (1890); Moore, *Handb. Fl. New South Wales* 19 (1893); Bailey, *Queensland Fl.* 4: 1314 (1901); Rodway, *Tasmanian Fl.* 165 (1903); Diels & Pritzel, *Bot. Jahrb. Syst.* 35: 201 (1905); Dixon, *Pl. New South Wales* 33 (1906); Maiden & Betche, *Census New South Wales Pl.* 82 (1916); Ewart, *Handb. Forest Trees Victoria* 124 (1925); Ewart, *Fl. Victoria* 522 (1931); Gardner, *Enum. Pl. Austral. Occ.* 44 (1931); J.M. Black, *Fl. South Australia ed. 2(2)*: 365 (1948); Blackall & Grieve, *How to Know Western Australia Wildflowers 1*: 168 (1954); Curtis, *Stud. Fl. Tasmania* 3: 597 (1967); Burbidge & Gray, *Fl. A.C.T.* 176 (1970); Beadle, *Evans & Carolin, Fl. Sydney Reg.* 152 (1972); Beadle, *Stud. Fl. North Eastern New South Wales* 2: 120 (1972); Willis, *Handb. Pl. Victoria* 2: 159 (1973).

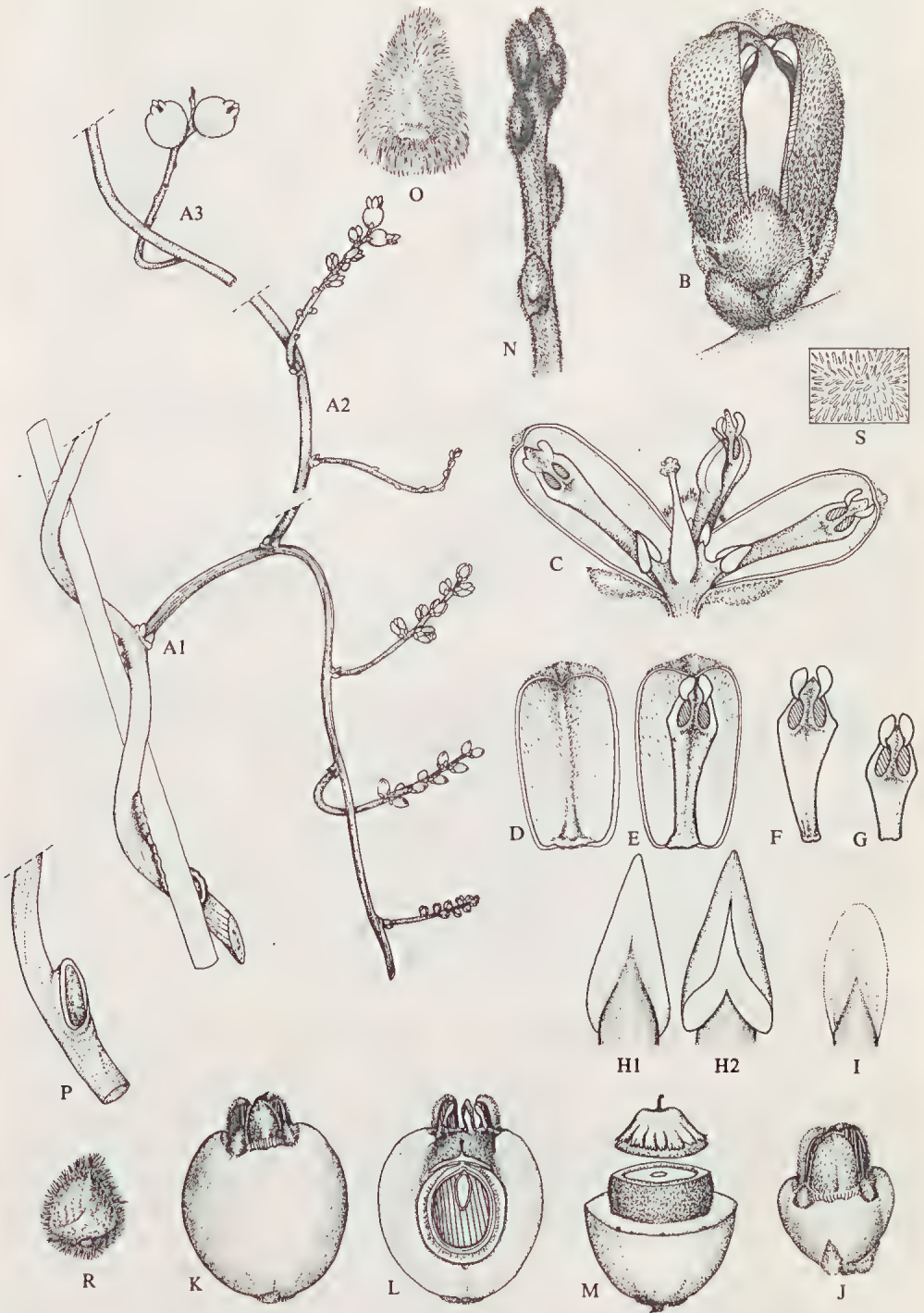
Type: R. Brown (Bennett 3020), Port Jackson (Australia), 3.ix.1803 (BM, lecto.; K, isolecto.). (lectotypified here).

Vernacular Names

"*Large Dodder-laurel*", Ewart, *Fl. Victoria* (1931); "*Devil's Twine*", Burbidge & Gray, *Fl. A.C.T.* (1970); "*Coarse Dodder-laurel*", Willis, *Handb. Pl. Victoria* (1973); "*Snotty gobbler*" (South Australia).

Stem (0.9-) 1.3-2 (-4) mm thick, glabrescent, green to reddish-green. *Haustoria* elliptic, 2-5 mm long. Young shoots pubescent. *Leaves* triangular, basifixed to ovate, peltate, c. 1 x 0.8 mm, red-pubescent, hairs 0.1-0.2 mm long and centrifugally spreading, appressed so the leaf appears ciliate or fimbriate; often centrally placed yellow gland furnished with transverse furrow. Leaves and bracts turning black on drying. *Inflorescence* a single or rarely clustered more or less elevated spike; peduncles (8-) 20-30 (-95) x (0.8-) 1 (-1.5) mm, usually darker than stem, covered with white and red, short retrorse hairs, (1-) 6-9 (-13) flowered; flowers commonly in upper half of peduncle, frequently one or two lower remote from the rest. Supporting bract triangular, basifixed, 1-2 x 0.8-1.2 mm, pubescent, hairs white and tinted red and black, centrifugally appressed; bracteoles similar but smaller. *Flowers* ovate, (2-) 2.4-2.6 (-3) x (1.3-) 1.5-1.7 (-2) mm subsessile to sessile; pedicel inconspicuous, 0.2-0.3 (-1) mm long, hidden by floral bracts. Floral bracts verticillate; bract triangular, c. 1 x 1-1.4 mm, hairs short, reddish, appressed, spreading centrifugally; bracteoles deltoid-ovate, 0.5-0.6 x 0.7-0.9 mm, indumentum similar. Receptacular tube short, densely pubescent with reddish and black

Fig. 21. *Cassytha melantha*. A, habit: A1, stem and inflorescence with flowers; A2, stem with inflorescence, lower with buds, upper with young fruits; A3, stem and inflorescence with mature fruits. B, flower, showing bracts and peduncle. C, flower with receptacle cut open to show stamens, staminodes, gland, ovary and receptacular tube. D, petal, from inside, showing dorsal rib. E, petal, from inside, with dorsi-basally attached stamen of the second whorl. F, stamen of the first whorl, front view, showing open loculi and upright flap. G, stamen, of the third whorl, front view. H, staminode, showing short stalk: H1, centrifugal view; H2, centripetal view. I, gland, enlarged to the same scale as the staminode. J, young fruit, showing verticillate bracts and perianth. K, mature fruit, showing bracts and perianth with slightly open orifice. L, longitudinally sectioned fruit, showing stone and orifice, surmounted by stamens and petals. M, fruit cut open to show the stone in horizontal section. N, young shoot with scale leaves. O, scale leaf, showing radiate pubescence and glabrous central gland. P, haustorium. R, sepal, from beneath. S, hairs on central portion of petal.



hairs. *Sepals* deltoid, (1-) 1.2 (-1.3) x (0.9-) 1 (-1.2) mm, pubescent, hairs white and black on centre of sepal, reddish on margin. *Petals* ovate, acute, (1.9-) 2.3-2.5 (-2.7) x (1.3-) 1.4-1.6 (-1.9) mm, pubescent on both sides with short, thick, retrorse, appressed black hairs, outside basally a reddish indumentum is frequent. Nine *stamens* fertile, flap elliptical, c. 0.4 x c. 0.2 mm; stamens of the first whorl narrow-rhomboid, (1.7-) 1.8-1.9 (-2.2) x (0.7-) 0.8 (-0.9) mm, filament often laterally expanded, sometimes with small lateral protuberances; stamens of the second whorl oblanceolate, (1.5-) 1.9-2 (-2) x (0.4-) 0.5 (-0.6) mm, cells obcordate, wider than filament, filaments terminally produced into a small, flat inflexed beak; stamens of the third whorl similar to those of second, 1-2 x c. 0.4 mm. *Staminodia* obcordate, c. 0.7 x c. 0.4 mm, shortly stalked, white, turning brown; gland ovate somewhat angular to hexagonal, c. 0.5 x 0.2-0.3 mm, white, turning brown, *ovary* fusiform, c. 2 x 0.5 mm, glabrous, stigma c. 0.3 mm across. Receptacular tube pubescent inside. *Fruit* globular, 10-15 mm across, glabrescent, light-green to cream-white, usually drying black, (7-) 8-9 (-10) mm across; petals dark-brown, leathery, rotate; orifice open. *Stone* globular, c. 0.5 mm across, black. (Fig. 21.)

Distribution (Map 12)

Endemic to Australia occurring in all States except Northern Territory and Queensland, from 30° latitude southwards, penetrating from the coast to far inland.

Flowering

Flowers from June to October, rare in November and December. Fruiting from September to December, but some specimens with fruits were found through January and February, only a few in March. Buds on inflorescences appear from February to May. The flowering period throughout Australia is most regular in this species and is confined to the coolest months of the year.

Morphology

This is the most robust representative in the genus, usually growing on shrubs and trees. One specimen (*J.Z. Weber 620*, Hindmarsh Waterfall, South Australia, 24.ix.1967 [AD]) has fasciculate and panicate inflorescences to 140 mm long, where the single branch is to 70 mm long and has 15 remote flowers. Another specimen with long peduncles, 95 mm long, (*A.B. Cashmore s.n.*, Kangaroo Island, South Australia, 19.vii.1933 [ADW 1096]) has 10 remote flowers along the peduncle, similar to *C. pubescens* (see morphology discussion) and *C. aurea* var. *candida*, but differs in the stouter and usually darker stem (more pronounced when dry), the dark-red to black appearance of the inflorescence and also retrorse short black hairs on the petals. Glabrescent fruits are most frequent but they are occasionally more hairy (*W.H. Harvey 5*, Colony of Victoria, September/December 1854 [TCD]).

Specimens examined

WESTERN AUSTRALIA: *Barrett 8* (PERTH). *Batt s.n.* (MEL 497, 58732). *Briggs 233a, 298* (NSW). *Brooke s.n.* (MEL 58643, 58674, 58676, 58726, 58744). *Brooker 3711* (PERTH). *Carrick 3956* (AD, PERTH). *Cawthorne 76* (PERTH). *Chinnock 3288* (AD, CANB, K, PERTH); *3349* (AD, CANB, PERTH); *4135* (AD). *Cronin s.n.* (MEL 58714). *Demarz 1045* (KINGS PARK). *Diels & Pritzel 587* (PERTH). *Donner 4583* (AD, P, PR). *Drummond 69* (MEL). *Fitzgerald s.n.* (NSW 135080). *Forrest s.n.* (MEL 58492). *George 8050* (PERTH). *Helms s.n.* (AD 97424454, MEL 58447-8, NSW). *Hugg 6948* (PERTH). *Knox 65x054* (PERTH). *Kenneally 1300* (PERTH). *Haegi 1011* (AD, HBG, M); *1191* (AD, NY). *Oldfield s.n.* (MEL 58483). *Orchard 1258* (AD, PERTH); *1382* (AD, CANB, PERTH); *1490* (AD, PERTH). *Parsons 192* (AD). *Paust 803, 870* (PERTH). *Royce 3649, 9073, 9211* (PERTH). *Stone 854* (CANB, PERTH). *Sullivan 25* (MEL). *Turner s.n.* (MEL 58667). *Weber 5221* (AD, NY); *5229* (AD, BM). *Whibley 4704* (AD, CANB); *5257* (AD, BRI). *Wilson 1646, 2898* (AD, PERTH).

NEW SOUTH WALES: *Beadle s.n.* (SYD). *Betche s.n.* (NSW 135103). *Blundell s.n.* (NSW 135081). *Boorman s.n.* (NSW 135082, 135096, 135099, 135101-2). *Burbidge s.n.* (NSW 135083). *Burken s.n.* (NSW 135095). *Cabbage 1364* (NSW, SYD); *2797* (NSW); *3238* (NSW, SYD). *Campbell s.n.* (NSW 106148, 135097). *Carolin 822* (SYD). *Carrick 3198* (AD, K, NSW). *Constable s.n.* (NSW 4621). *Coveny 2548* (NSW); *s.n.* (NSW 127719).

Crisp 1620 (AD, BISH, CANB). *Cunningham* 3, 222, 552 (NSW). *Donner* 4725 (AD, M, TCD). *Dwyer s.n.* (NSW 135098). *Ford s.n.* (NSW). *Hamilton s.n.* (NSW 135092-3). *Harley* 13562 (CANB). *Holding s.n.* (MEL 58488-90, 58740). *Ingram* 3471, 4931, 8264, 8658, 10470 (NSW); *s.n.* (NSW). *Johnson* 1225 (NSW); *s.n.* (NSW 135094). *Lauterer s.n.* (MEL 58724); *s.n.* (BRI 032956). *Logan s.n.* (NSW 135100). *MacGillivray* 922 (NSW). *McBarron* 7307 (NSW). *Mein s.n.* (MEL 58487). *Moore* 2692 (BRI, CANB); 3120 (CANB). *Nash s.n.* (AD 97015456). *Story* 6805 (CANB, NSW). *Taylor* 4 (NSW). *Whaite* 2309, 3369 (NSW).

VICTORIA: *Anderson s.n.* (MEL 58465). *Aston* 31, 120, 403, 438, 992, 1062 (MEL). *Beaglehole* 6976, 16954, 21082, 22452 (BEAUGLEHOLE); 29191 (AD, BEAUGLEHOLE). *Bird s.n.* (MEL 58725). *Brown s.n.* (MEL 62376). *Canning* 3013 (AD). *Carrick* 3081 (AD, MEL); 3335 (AD). *Cullimore* 2 (MEL); 181 (BRI, MEL). *Davies* 35 (NSW). *Dellar s.n.* (MEL 58700). *Dillon s.n.* (MEL 62373). *Funk s.n.* (MEL 58662). *Hart s.n.* (MEL 58473-4). *Jephcott s.n.* (MEL 58494). *Matthews s.n.* (MEL 58491). *Merrall s.n.* (MEL 58730). *Moore* 3626 (CANB). *Morris* 1534 (NSW). *Mueller s.n.* (MEL 58449-51, 58453, 58455, 58458, 58460, 58477). *Orchard* 2449 (AD, CHR); 2700 (AD, HAL, LY). *Pitcher s.n.* (MEL 58462). *Reader* 23 (MEL); *s.n.* (MEL 58452, 58459, 58681). *Sullivan* 3 (MEL 58620). *Tracey* 53 (MEL 58627). *Wallace* 53 (MEL). *Walter s.n.* (NSW 135078). *Watts* 455 (NSW). *Weber* 3718 (AD); 5235 (AD, M). *Williamson s.n.* (NSW 135077). *Wilson* 11 (MEL).

TASMANIA: *Barker* 934 (AD, HO). *Burns s.n.* (HO 7468). *Chinnock* 2234 (AD, NT). *Cleland s.n.* (AD 96841143, 97226170). *Curtis s.n.* (HO 7472-3). *Davies s.n.* (NSW 135079). *Hannaford s.n.* (HO 7469). *Hooker s.n.* (MEL 58445 & 58486). *Long* 565 (CANB, HO). *Rodway s.n.* (HO 7470). *Story s.n.* (MEL 58481, 58734).

SOUTH AUSTRALIA: *Alcock* 51B, 2419, 2923 (AD); 4789 (AD, SYD); 5300, 5533 (AD). *Anon.* (Herb. J.M. Black) *s.n.* (AD 97423313, 97423331, 07424478-9, 97424481-2). *Barker* 1749 (AD, PRC); 1758 (AD, BISH); 3635 (AD, PRC). *Bates* 279 (AD); *s.n.* (AD 97615023, 97626081, 97722506). *Beak* 98 (AD). *Blaylock* 362, 388, 2305 (AD). *Bowen* 245 (AD). *Cabbage* 248 (NSW). *Canning* 2206 (CANB). *Carrick* 3559 (AD, M, W); 3765 (AD). *Carter s.n.* (ADW 24618). *Cashmore s.n.* (ADW 1096). *Cleland s.n.* (AD 966090646-7, 96601720). *Chinnock* 1345 (AD, BRI, OXF); 2410 (AD); 2664 (AD, CHR); 2775 (AD, B, HAL). *Chorney* 711 (AD, NBG, SI). *Copley* 515 (AD, FI, OXF); 866 (AD); 955 (AD, H, TI); 4648 (AD, NY). *Cooper s.n.* (AD 96229398, 96144048). *Crisp* 363 (AD). *Czorny* 97 (AD, B); 966 (AD, UPS, WU); 804 (AD). *Donner* 816 (AD, MT, JB); 997 (AD); 4753 (AD, PE). *Eardley s.n.* (ADW 1095, 3958). *Eichler* 14164 (AD, G, PRE, NY); 16205 (AD); 19134 (AD, BM, K, M, NY); 19713 (AD, BRI); 19271 (AD, G, L). *Everist* 5757 (AD). *Fieldhouse* 49 (AD). *Forde* 463 (CANB). *Gardner s.n.* (AD 96323103). *Gill* 143 (MEL); *s.n.* (NSW 135069). *Grivel s.n.* (AD 96929617). *Haegi* 359, 434, 439, 419 (AD); 568 (AD, K, M, NY, P); 590 (AD, BRI, CANB). *Haylock* 70 (AD). *F. Hill* 604 (BM). *R. Hill s.n.* (AD 96322048). *Hilton* 1607 (ADW). *Hornsby s.n.* (AD 98003242). *Hunt* 707, 2392 (AD). *Hussey s.n.* (MEL 62374). *Ising s.n.* (AD 96221179, 96506103, 96603497, 97012074, 97127050). *E. Jackson* 510 (AD, UC, Z); 760 (AD); 2331 (AD, CANB, NSW). *G. Jackson* 434, 459 (AD); 510 (AD, CANB); 512 (AD); 519 (AD, OXF, P); 554 (AD, MEL, PERTH); 564, 583, 584 (AD). *Kraehenbuehl* 1093, 1379, 1529 (AD); 1552 (AD, M); 2488 (AD, HBG); 2499 (AD); 2795 (AD, BISH); 2796 (AD, BA); 3040 (AD). *Kuchel* 24, 3313 (AD). *Litchfield s.n.* (ADW 8868). *Lothian* 5414 (AD, CANB). *Mack* 1 (AD). *Nash s.n.* (AD 9738073). *Orchard* 2021 (AD, HBG, TCD); 2196 (AD, CHR). *Painter & Heath* 7 (AD). *Pearce s.n.* (ADW 29662). *Phillips* 138 (NSW). *Richard s.n.* (AD 97424453, MEL 58604, 58680). *Roach* 50 (AD, OXF). *Rogers s.n.* (NSW 135072). *Rohrlach* 383 (AD). *Saddler s.n.* (ADW 32047). *Sharrad* 710, 993 (AD). *Shaw s.n.* (AD 97244290, 9724308). *Smith* 3 (MEL). *Specht* 2027, 2231, 2429, 2683 (AD); *s.n.* (AD 97331293). *Spooner* 812, 911, 1429, 1520, 1927 (AD). *Stear s.n.* (NSW). *Symon* 823A (AD, ADW, CANB); 952 (ADW); 1497, 2928 (ADW, PERTH); 3633, 4956 (ADW); 6259 (ADW, DAV); 7595 (ADW); 8234 (AD, ADW, CANB). *Tepper s.n.* (AD 966100776, 97424452, MEL 58593, 58495). *Turner s.n.* (AD 96222113, 97603357, 97612337). *Velleman* 032 (AD). *Weber* 620 (AD); 1729 (AD, H, L); 1823 (AD); 1951 (A, AD, B); 1955 (A, AD, B, G); 1957 (AD, M, HBG, NY); 1958 (AD, BRI, CANB, NT); 1972 (AD, NT); 3225 (AD, CANB, PERTH); 3693, 3705 (AD); 3712 (AD, TRN); 3722 (AD, BRI); 3766 (AD); 3772 (AD, HAL, LY); 3798 (AD, HO); 3817 (A, AD, B); 3870 (AD, NT); 4415 (AD); 4438, 5231 (AD, CANB); 5234 (AD, FRI); 5238 (AD). *Wheeler* 418 (A, AD); 490 (partly) (AD); 823 (AD, COLO); 910, 1105 (AD). *Whibley* 1639, 1929 (AD); 1991 (AD, AK); 3660 (AD, TCD); 5813 (AD). *Wilkinson s.n.* (ADW 18353). *Wilson* 56 (AD, UC); 993 (AD); 1430 (AD, MEL, OSH); 1462 (AD, HBG, G, LY); 1582 (AD, CANB, PERTH); 1722 (AD, NT). *Woolmer* 109 (AD).

13. *Cassytha pomiformis* Nees in *Lehm., Pl. Preiss.* 620 (1845); *Walp., Ann.* 1: 579 (1848); *Meisn. in DC., Prod.* 15: 253 (1864); *Benth., Fl. Austral.* 5: 313 (1870); *F. Muell., Second Census Austral. Pl.* 7 (1889); *Diels & Pritzel in Engl., Bot. Jahrb.* 35: 202 (1905); *Gardner, Enum. Pl. Austral. Occ.* 44 (1931); *Webb, J. Austral. Agr. Sci.* 19: 146 (1953).

Type: *L. Preiss* 1625, *Prope oppidulum* Fremantle, Dec. 1838 (MEL 58520, holo.; MEL 59521, NY, iso.). (nominated here.)

C. ceratopoda *Meisn. in DC., Prod.* 15: 257 (1864); *Benth., Fl. Austral.* 5: 313 (1870).

Type: *J. Drummond* 150, (? "In colonia Swan River", Western Australia) (K, (?) MEL 58517, syn). *J. Drummond* 151 (? "In colonia Swan River", Western Australia) (K, NY, (?) MEL 58518, syn.). Both

Drummond collection in K & NY have the name of the collector (Drummond) and number only, those in MEL only his initials undoubtedly written by F. Mueller and matching the types in K & NY. No other Drummond collection of this taxon was located in MEL by the present author. (These two collections were erroneously cited by Ewart & Davies (Fl. Northern Territory 113 (1917) for "Northern Australia".)

C. multiflora Nees in Lehm., Pl. Preiss. 621 (1845) (vide Bentham [1870] as syn. of *C. pomiformis* var. *pubiflora*).

Type citation: "King Georges Sound. All. Cunningham in herb. Schauer. Herb. Preiss. No. 2629". Not seen.

C. subcapitata Meisn. in DC., Prod. 15: 253 (1864); Benth., Fl. Austral. 5: 313 (1870).

Type: J. Drummond 63, Swan River (1845) (MEL 58552, lecto; K, NY, iso.).

C. pomiformis var. *pubiflora* Benth., Fl. Austral. 5: 313 (1870).

Type: Based on *C. multiflora* Nees in Lehm., Pl. Preiss. 621 (1845) - *Preiss* 2629; not seen.

Stem (0.2-) 0.5-0.7 (-1.3) mm thick, yellow-green or grey-green to dark-green (dried), covered with bristly white hairs or glabrescent. Young shoots pubescent. *Leaves* ovate, peltate, 1-1.5 x 0.5-0.8 mm, with or without dorsal gland, retrorse pubescent, ciliate basally, cream-green, turning brown. *Haustoria* irregular in shape, sometimes 1-4 mm long with ring of hairs at the attachment. *Inflorescence* single, sometimes paired fasciculate, panicle of racemes or umbel, to 45 mm long, pubescent. Supporting bract triangular, c. 0.7 mm long and wide, pubescent, brown (dried); bracteoles similar, smaller or larger, attached at the base of peduncle or carried variously on it. Peduncles short or long, 2.5-30 x 0.6-0.8 mm in young stage, often becoming clavate with age, 1-1.8 mm



Fig. 22. *Cassytha pomiformis*. A, stem and inflorescence with flowers. B, clavate peduncle with young fruit. C, flower, showing pedicel with basal bracteoles. D, stamens, front view, showing open loculi and upright flaps: D1, second whorl, showing cilia on the filament; D2, first whorl, showing laterally expanded filament with cilia; D3, third whorl. E, staminode, centripetal view, showing white apical gland. F, glands, centripetal view, showing white apical glands. G, ovary and lower style, showing hairs. H, fruit, showing basal bracts and perianth with closed orifice.

thick. *Flower* ovate, 2-2.5 x 1.3-1.6 mm, outside yellow, inside white. Pedicels 0.4-1.5 x 0.2-0.8 mm, distinctly white pubescent. Floral bracts verticillate at base of pedicel or in two planes. Floral bract ovate, peltate, c. 1.4 x 0.7 mm or triangular and basifixed, c. 0.7 x 0.5 mm, both pubescent, brown; bracteoles triangular, c. 0.5 x 0.3 mm, pubescent, brown. Receptacular tube short, white-pubescent, suddenly contracted into the pedicel. *Sepals* triangular-ovate, c. 0.6 x 0.6 mm, yellow-brown, pubescent outside, turning brown. *Petals* ovate, subacute, 1.5-1.9 x 0.8-1 mm, antrorse pubescent on both sides, yellowish, turning dark brown. Nine *stamens* fertile, white, turning brown; stamens of the first whorl obovate, 1-1.2 x c. 0.7 mm, with filament under the cells more or less expanded laterally, occasionally ciliate; stamens of the second whorl oblanceolate, obtuse, 1-1.2 x 0.3-0.5 mm, cells obcordate, wider than filament which is sometimes ciliate; stamens of the third whorl oblanceolate, acute, c. 1 x c. 0.5 mm, cells wider than filament and bulging over staminodes and glands. *Staminodes* narrow-pyramidal, c. 0.6 x 0.3 mm, white, turning brown, with white apex; glands ovoid, dorsi-ventrally flattened, c. 0.5 x 0.3 mm, white, turning brown, crested white. *Ovary* fusiform, c. 1.5 x 0.5 mm, glabrous or sprinkled with hairs. Receptacular tube pubescent inside. *Fruit* fusiform-globose, c. 10 x 6 mm, grey pubescent, yellow-green, turning green-black, globose portion carried on distinct darker pedicel and sometimes supported by floral bracteoles. *Stone* globular, c. 5 mm across, dark brown. (Fig. 22.)

Distribution (Map 13)

Endemic to south-western Western Australia, from Geraldton southwards to King George Sound, eastwards to Esperance and also inland.

Flowering

Flowering specimens have been collected from July to January, specimens in fruit from August to December. Specimens with flower and fruits are frequent.

Notes

Specimens with paired inflorescences show diversity in the age of peduncles, where the shorter and thicker carried fruits or were barren, the longer and less clavate carried flowers.

Specimens examined

WESTERN AUSTRALIA: *Backhouse s.n.* (K). *Beaglehole 11863, 49292* (BEAGLEHOLE). *Carne s.n.* (PERTH). *Chinnock 3166* (AD, K, PERTH); *3278* (AD, M, MEL); *3696* (AD, CANB). *Davies 504* (AD). *Demarz D1798* (KINGS PARK). *Diels & Pritzel 233* (PERTH). *Donner 4582* (AD, PERTH). *Drummond suppl. 65* (MEL, K, NY). *Easton s.n.* (MEL 58706). *Eichler 20103* (AD, NSW, PERTH); *20364* (AD, PERTH); *20402* (AD). *Forrest s.n.* (MEL 58603). *George s.n.* (PERTH). *Haegi 1213* (AD, HO, TCD). *Harvey 6* (K, NY, TCD). *Keighery 1200* (KINGS PARK). *McFarland 1259* (AD, BRI, PERTH). *Morris s.n.* (MEL 58519). *Morrison s.n.* (BM, BRI, K). *Mueller s.n.* (MEL, 52338, 58515-6, 58689, 58691-2, 58753). *Orchard 4233* (AD). *Preiss 28* (K); *1622* (HBG). *Pritzel 144* (AD, BM, G, K, M, NSW). *Royce 8105* (AD, PERTH). *Sewell s.n.* (MEL 58634, 58705). *Stoward 387* (K). *Weber 5033* (AD, CANB, K, PERTH); *5034* (AD, BRI, HO, K, NSW, NY, W, Z); *5037* (AD, G); *5143* (AD, OXF, P). *Whibley 3740* (AD, BM); *4760* (AD); *4974* (AD, PERTH).

14. *Cassytha racemosa* Nees in Lehm., Pl. Preiss. 1: 621 (1845); Walp., Ann. 1: 579 (1848); Meisn. in DC. Prod. 15: 257 (1864); Benth., Fl. Aust. 5: 312 (1870); Bailey, Synops. Queensl. Pl. 427 (1883); F. Muell., Second Census Aust. Pl. 7 (1889); Bailey, Cat. Queensl. P. 39 (1890); Bailey, Queensl. Fl. 4: 1315 (1901); Diels & Pritzel in Engl., Bot. Jahrb. 35: 202 (1905); Bailey, Compreh. Catal. Queensl. Pl. 439, f. 425 (1913); Gardner, Enum. Pl. Austral. Occid. 44 (1931); Blackall & Grieve, How to Know W.A. plants 169 (1954).

Type: L. Preiss 1623, Prope oppidulum Fremantle, Perth, Western Australia (MEL 58594, lecto.; K, MEL 58597, iso.). (lectotypified here.)

C. subcapitata Meisn., in DC., Prod. 15: 253 (1864) partly; Benth., Fl. Austral. 5: 212 & 213 (1870).

Type: *J. Drummond 203*, In colonia Swan River, Western Australia (K, iso.).

C. racemosa var. *genuina* Hochreutiner, *Candollea* 2: 365 (1925) nom. illeg., based on specimen—*B.P.G. Hochreutiner 2972*, Claremont près de Perth, 16.ii.1905 (G).

Stem (0.3-) 0.6-.08 (-2) mm thick, glabrescent to pubescent, light yellow-green or brownish to dark-green. Young shoots pubescent, *leaves* 1.5-2.5 x 0.5-0.8 mm, often with a central gland, glabrescent or more or less ciliate, narrow-ovate and peltate or triangular-ovate and basifixed (eastern specimens). *Haustoria* elliptical, c. 1 mm across, often several in row, long when not attaching to host. *Inflorescence* single, paired or fasciculate, sometimes paniculate, final racemes short or long, peduncles 3-30 x 0.5-1 mm, glabrescent to pubescent, (1-) 4-8 (-10) flowered. Supporting bract ovate and peltate, or triangular and basifixed, 1-3 x c. 1 mm, brown, pubescent to glabrescent, ciliate; bracteoles angular-ovate to ovate, 0.5-2 x 0.3-1 mm, attached basally, pubescent to glabrescent, ciliate. *Flowers* in a loose raceme, or in a head, pedicellate, ovoid, 1-2 x 0.9-1.5 mm, white to greenish-yellow, pubescent. Pedicel 1-2 (-10) x 0.3-0.8 mm, pubescent or glabrescent, (in f. *racemosa* at fruiting swells and integrates as an obconical base to the widened receptacular tube). Floral bracts in two planes, bract at base of pedicel ovate and peltate, or triangular and basifixed, 0.5-1.2 x 0.3-0.5 mm, pubescent to glabrescent, ciliate; bracteoles smaller, remote, distally peltate to basifixed, acute, 0.5-0.7 x c. 0.5 mm, pubescent to glabrescent, ciliate, on top of the pedicel subtending the flower, on fruits inserted on the obconical receptacular tube. *Sepals* triangular-ovate to round, 0.5-0.7 mm, pubescent to glabrescent, ciliate. *Petals* ovate, bluntly acute, 1-1.8 x 0.8-1.5 mm, pubescent to glabrescent outside, with appressed white hairs inside, in fruit brown to black and leathery, incurved to rotate. Fertile *stamens* six, light yellow or white; stamens of the first whorl spatulate, obtuse, c. 1-1.5 x 0.6-0.7 mm, cells obcordate, expanded tip often as wide as the cells, filament more or less expanded laterally but not exceeding the cells; 3 stamens of the second whorl (opposite the petals), reduced to staminodes, filiform c. 1 x 0.3 mm or often adhering to the petal throughout its length, appearing only as a bulging, glabrous mid-rib; stamens of the third whorl narrow-obovate, c. 1.2 x c. 0.5 mm, cells obcordate, more or less bulging, tip often inflated. Staminodes conical, c. 0.5 x c. 0.35 mm, commonly white, turning brown, occasionally with white apex; glands ovoid, c. 0.5 x 0.3 mm, mostly white, occasionally with white tip. *Ovary* fusiform, 1-1.5 x c. 0.5 mm, pubescent all over or only in a transverse median ring. Receptacular tube pubescent inside. *Fruit* globose to pyriform, 7-11 x 5-8 mm, smooth obconical base carrying globose portion which is smooth or furnished with six bulging vertical lobes, pubescent to glabrescent. Stone ovoid, c. 4 x c. 3.5 mm, black, rough. (Figs 23-25.)

Distribution (Maps 14 & 15)

Endemic to Australia.

Flowering

Flowers all year round.

Notes

Bentham's (1870) delimitation into varieties was applied to the extreme pubescent forms; the present writer found great variation in this respect and was unable to segregate on characters of indumentum but rather on different forms of leaves, bracts and fruits.

The present author cannot segregate Western Australian specimens without fruits into forms and these are therefore mapped and listed separately.

Specimens examined—in flowers only

WESTERN AUSTRALIA: *Alexander s.n.* (PERTH). *Andrews 725* (BM); *s.n.* (PERTH). *Aplin 1242, 1376* (PERTH). *Ashby 5165* (AD, CANB, MEL, PERTH). *Batt s.n.* (MEL 58669). *Bennett s.n.* (PERTH). *Brooker 1727* (PERTH). *Butler s.n.* (PERTH). *Carrey s.n.* (MEL 58593). *Diels & Pritzel 35* (PERTH). *Drummond 133*

(K, MEL); 229 (MEL); *s.n.* (K, MEL 58590). *Eichler* 20081 (AD). *Fairal* 2206 (PERTH). *Forrest s.n.* (MEL 58628). *Gardner* 5006 (PERTH); *s.n.* (PERTH). *George* 2105, 6382, 7181 (PERTH). *Hamilton s.n.* (NSW 135120). *Harvey* 2 (BM, K, TCD); 3 (K, NY, TCD); *s.n.* (BM, TCD). *Hey* 26 (BM). *Jackson s.n.* (NSW 135108). *James* 184 (PERTH). *Keighery* 705, 1256, 1546, 1570 (KINGS PARK). *Kenneally* 72/16 (PERTH); 2442 (AD, PERTH). *Kissane* 15 (PERTH). *Koch* 2112 (NSW, PERTH). *Maiden s.n.* (NSW 135124). *Morrison* 307 (NSW); 8435 (BM, K, PERTH); (9421; 308) (NY, PERTH); (10323; 306) (G, K); *s.n.* (BM, BRI 158281, K, PERTH). *Mueller s.n.* (MEL 58583, 58758). *Muir s.n.* (MEL 58736). *Preiss* 16 (K); *s.n.* (G). *Oldfield s.n.* (MEL 58585-6, 58690). *Paust* 10 (PERTH). *Pritzel* 48 (NSW, PR). *Royce* 107, 4239, 7768, 8097, 8301, 8269, 8796, 9800 (PERTH). *Salasoo* 4207 (NSW); *Scrymgeour* 184 (PERTH). *Steffanoni s.n.* (ADW 17235). *Stokes s.n.* (PERTH). *Wilson* 4178. *Wilson* 8083 (AD, PERTH). *Wittwer s.n.* (KINGS PARK).

Key to Forms

1. Leaves and bracts triangular, basifixed (eastern)..... 14c. *f. muelleri*
 Leaves and bracts ovate, peltate (western) 2
2. Fruits lobed 14a. *f. racemosa*
 Fruits smooth..... 14b. *f. pilosa*

14a. *Cassytha racemosa* forma *racemosa*

Leaves and bracts ovate, peltate. *Fruit* globose to pyriform, 6-8 x 6-7 mm, glabrescent; base of fruit obconical, short and wide, including expanded pedicel between bract and bracteoles; globose portion divided into 6 vertical, thick, bulging lobes, each topped by a

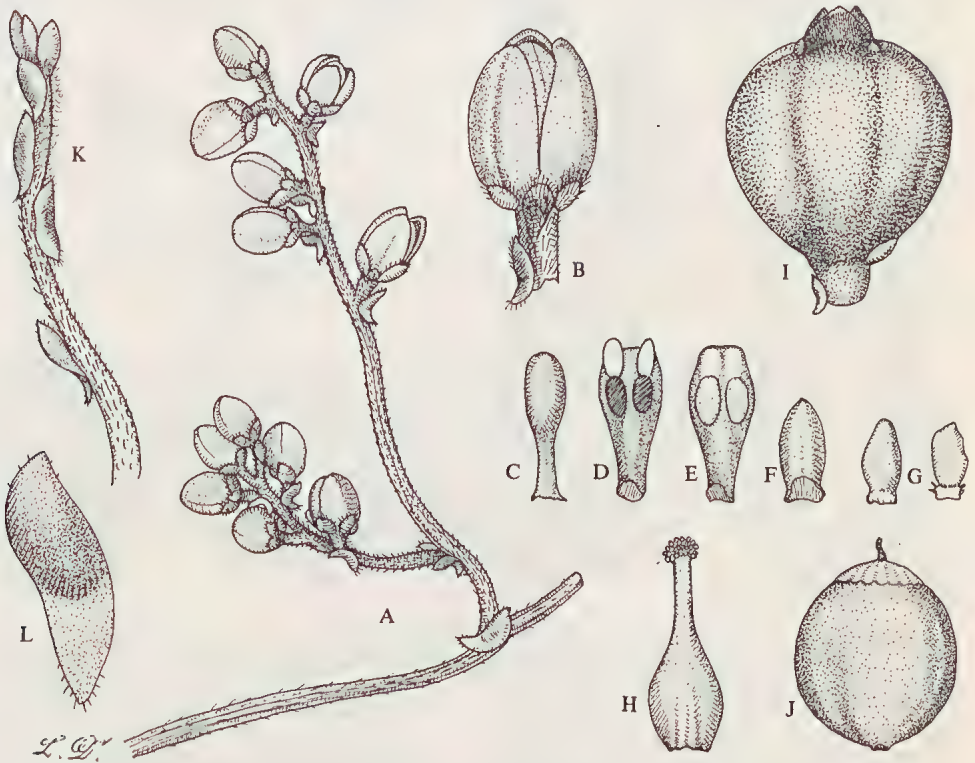


Fig. 23. *Cassytha racemosa* f. *racemosa*. A, stem and inflorescence with flowers in a paniculate raceme. B, flower, showing pedicel with basal bract and remote higher bracteoles subtending the flower. C, sterile stamen of the second whorl. D, stamen of the first whorl, front view, showing open loculi and upright flaps. E, stamen of the third whorl, front view, showing loculi. F, staminode. G, glands. H, ovary. I, lobed fruit, showing pedicel with basal bract and remote higher bracteole subtending the fruit, the perianth enclosing the orifice. J, stone. K, young shoot with peltate scale leaves. L, scale leaf, showing upper fleshy anterior portion.

perianth segment; orifice covered by the horizontal incurved perianth and androecium. Floral bracteoles in flower attached to the pedicel; in fruit clasping and embedded in basal portion. (Fig. 23.)

Distribution (Map 14)

Endemic to Western Australia in the South West Division, spreading from Shark Bay southwards to Pemberton, eastwards approaching the Stirling Range, mostly confined to flats near the sea.

Similarities

The ovate peltate leaves show similarities with *f. pilosa*, but the lobed, quite globular and smaller fruits of this form differ from the smooth more pyriform fruits of *f. pilosa* and *f. muelleri*. The pedicel of *f. racemosa* is integrated as a widened (ob) conical part of the fruit: in the other two forms it is quite distinct, cylindrical and narrow.

Specimens examined

WESTERN AUSTRALIA: *Barker* 2238 (AD, MEL, PERTH); 2297 (AD, BRI, CANB). *Beaglehole* 12365 (BEAUGLEHOLE). *Burbridge* 7988 (CANB). *Chinnock* 3187 (AD, HO, K, NSW). *Drummond* 133 (BM, NY, TCD); 229 (BM, G, TCD); *s.n.* (MEL 58592). *Eichler* 15763 (AD). *Fitzgerald s.n.* (NSW 135104). *Helms s.n.* (PERTH). *Jackson* 3148 (AD, HBG, M). *Koch* 2578 (MEL). *Meebold* 477 (M). *Morrison* 1301 (K); 9422 (BRI, K, PERTH); *s.n.* (BM, BRI 158218, 158235, K). *Mueller s.n.* (MEL 58755, 58756). *Orchard* 4241 (AD, AK). *Paust* 1401 (PERTH). *Pritzel* 48 (AD, BM, G, K, M). *Royce* 8236 (PERTH). *Salasoo* 4271 (NSW). *Taylor per Shugg* 13 (PERTH). *Weber* 5105 (AD, CANB, G, PERTH). *Wilson* 6266 (AD, PERTH).

14b. *Cassyltha racemosa* forma *pilosa* (Benth.) J.Z. Weber, stat. et comb. nov.

C. racemosa var. *pilosa* Benth., Fl. Austral. 5: 312 (1870).

Type: *A. Oldfield*, King George Sound, Western Australia (MEL 58581, lecto.; MEL 58580, iso.). (lectotypified here).

C. umbellata Meisn. in DC., Prod. 15: 258 (1864); Benth., Fl. Austral. 5: 312 (1870), partly.

Type: *W.H. Harvey* 5, near Cape Riche, Western Australia, March 1854 (K, lecto.) (lectotypified here). Two other collections, labelled *Harvey* 5, have been seen: Between Perth and King George Sound, (W. Australia) Apr., July, 1854 (TCD) (= *C. racemosa* f. *pilosa*); and Colony of Victoria, Sept./Dec., 1854 (TCD) (= *C. melantha*).

Leaves and bracts ovate, peltate. *Fruit* variously pyriform to globose, smooth, 9-11 x 3.5-7 mm, pubescent to glabrescent, greenish to honey-yellow, turning dark-green to black. Perianth and androecium vertical to slightly rotate. Southern fruits (south of 29° lat.) are more pyriform, c. 10 x c. 4 mm with conspicuous, sometimes with a reddish glandular ring apically, gradually narrowing towards the quite distinct pedicel where the floral bracteoles clasp the (ob) conical base of the receptacular tube. Northern fruits are more globose, c. 9 x c. 7 mm, lacking a glandular ring, the receptacular tube not gradually but quite suddenly narrowed into a distinct pedicel. (Fig. 24.)

Distribution (Map 14)

Endemic to Western Australia along the western and southern coast from North West Cape, southwards from Shark Bay through the South West Division, entering the Eucla Division to Israelite Bay.

Similarities

This form shows similarities with *f. racemosa* in the ovate and peltate leaves but differs in the smooth more pyriform fruits, similar to those of *f. muelleri*.

Notes

C. umbellata Meisn., which Bentham (1870, p. 312) regarded as "rather half-monstrous state of *C. racemosa* var. *pilosa*", was apparently based on *W.H. Harvey* 5. One of the duplicates of this collection, housed at K, is the type of *C. umbellata* and is

labelled in ink; the other, housed at TCD, is annotated in pencil and was collected "Between Perth and King George Sound, April/July, 1854". The latter is advanced in fruit, but not fully developed, having the globose portion on a rather long, narrow stalk. This occurrence is not rare in younger fruits.

Specimens examined

WESTERN AUSTRALIA: *Aplin* 2099 (PERTH). *Blackall* 4386 (PERTH). *Brooke* s.n. (MEL 58642, 58719). *Chinnoek* 3299 (AD, LY, OXF). *Canning* s.n. (CBG 038579, NSW). *Donner* 2724 (AD, PERTH); 2989 (AD, CANB, PERTH). *Drummond* 229 (K, MEL). *Eichler* 19899 (AD, CANB, CHR, NY, PERTH, UPS); 20079 (AD, CANB, K, PERTH). *Fitzgerald* s.n. (NSW). *George* 6554 (PERTH). *Goodall* 1876 (PERTH). *Jackson* 1270 (AD, PERTH, TCD); 1313 (AD, HO, PERTH); 1407 (AD, NY, PERTH). *Keighery* 826, 1418 (KINGS PARK). *Koch* 2534 (NSW). *Maiden* s.n. (NSW 135125). *Meebold* 7155, 10073 (M). *Morrison* 7410 (K). *Mueller* s.n. (MEL 58484, 58589, 58638-9, NSW 135105). *Nash* s.n. (AD 97050163). *Orchard* 1682 (AD, CHR, HO, PERTH). *Royce* 108, 2821, 8655, 9904, 9924 (PERTH); s.n. (PERTH). *Sewel* s.n. (MEL 58647). *Weber* 5108 (AD, PERTH); 5152 (AD, K, M). *Wilson* 2968 (AD, CANB, PERTH); 5400 (AD, PERTH).

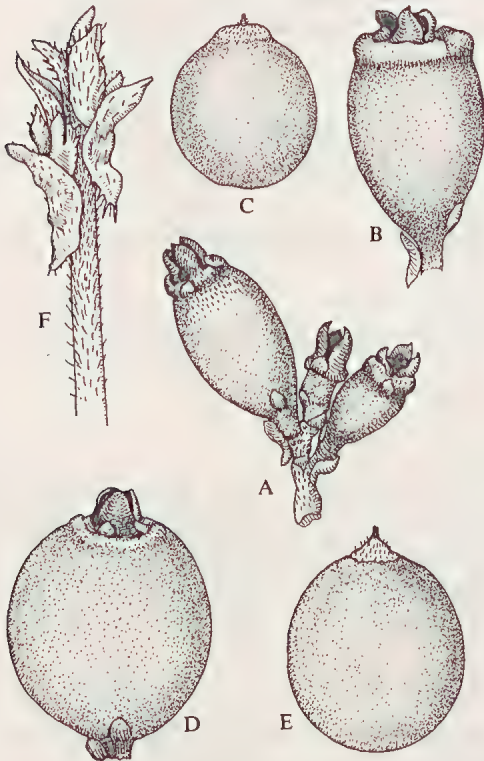


Fig. 24. *Cassylha racemosa* f. *pilosa*. A, inflorescence, showing fruits in different stages of maturity. B, mature smooth pyriform fruit, showing pedicel with basal bract and remote higher bracteole subtending fruit; apical glandular ring encircling the perianth, with open orifice. C, stone or pyriform fruit (B). D, mature smooth globose fruit, showing pedicel with basal bract and remote higher bracteole subtending the globose fruit; apical faint glandular ring encircling the perianth with a slightly open orifice. E, stone of globose fruit (D). F, young shoot with peltate scale leaves.

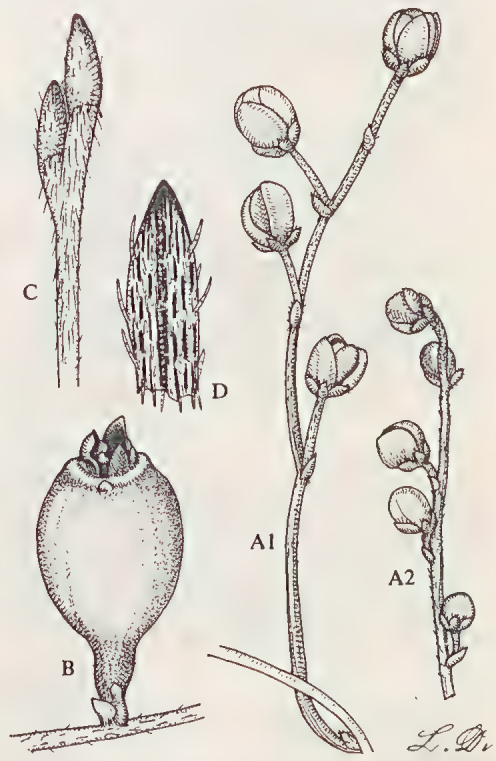


Fig. 25. *Cassylha racemosa* f. *muelleri*. A, inflorescence with flowers in a raceme, showing pedicellate flowers: A1, with stem basally; A2, showing hairs on the peduncle. B, pyriform fruit, showing cylindrical pedicel with basal bract and remote higher bracteole supporting the obconical narrow base; apical glandular ring encircling the perianth, with open orifice. C, young shoot, showing triangular scale leaves attached basally. D, scale leaf, enlarged, showing hairs.

14c. *Cassytha racemosa* forma *muelleri* (Meisn.) J.Z. Weber, stat et comb. nov.

C. muelleri Meisn. in DC., Prod. 15: 257 (1864); Benth., Fl. Austral. 5: 312 (1870); Bailey, Queensl. Fl. 4: 1315 (1901); Domin, Bibl. Bot. Band 22, Heft 89/2: 680 (1925).

Type: *F. Mueller*, Moreton Island, Queensland, Australia, August 1855 (MEL 58598, lecto.; K—2 sheets, NY, iso.) (lectotypified here.)

C. racemosa non Nees, sensu Benth., Fl. Austral. 5: 312 (1870), p.p. as to syn. *C. muelleri* Meisn.

Leaves and bracts triangular and basifixed, c. 1.5 x c. 0.8 mm, glabrescent, ciliate, dark brown (in sicco). Fruits smooth, pyriform, 8-9 x 4-5 mm, glabrescent, dried dark-green to brown, glandular ring well developed on top, basal obconical portion of receptacular tube gradually narrowing towards pedicel; pedicel is distinct between bract and bracteoles, hardly enlarged; perianth and androecium vertical, orifice open. (Fig. 25.)

Distribution (Map 15)

Occurs in the south-east of Queensland from Gympie south, around Brisbane and westwards towards Crows Nest; in New South Wales it is limited to Rocky Creek, between Cooldale and Grafton.

Similarities

This form shows similarities with *f. pilosa* in the smooth and pyriform fruits but differs from both other forms in the triangular basifixed leaves and bracts.

Notes

Stems of Queensland specimens are thinner than those from New South Wales which are as thick as the two western forms.

Specimens examined

QUEENSLAND: *Everist s.n.* (BRI 024805). *Smith 323, 14820* (BRI). *White s.n.* (BRI 177839, NSW 135106). *Anon s.n.* Marochy R. (BRI 177836).

NEW SOUTH WALES: *Coveny 1857* (NSW); *4981* (AD, NSW).

Nomen Dubium

Cassytha coronata Nees in Lehm., Pl. Preiss. 1: 620 (1845); Walp., Ann. 1(4): 679 (1849); Meisn. in DC., Prod. 15: 254 (1864); Benth., Fl. Aust. 5: 309 (1870); Diels & Pritzel in Engl., Bot. Jahrb. 35: 202 (1905); Gardner, Enum. Plant. Australe Occ. 44 (1931).

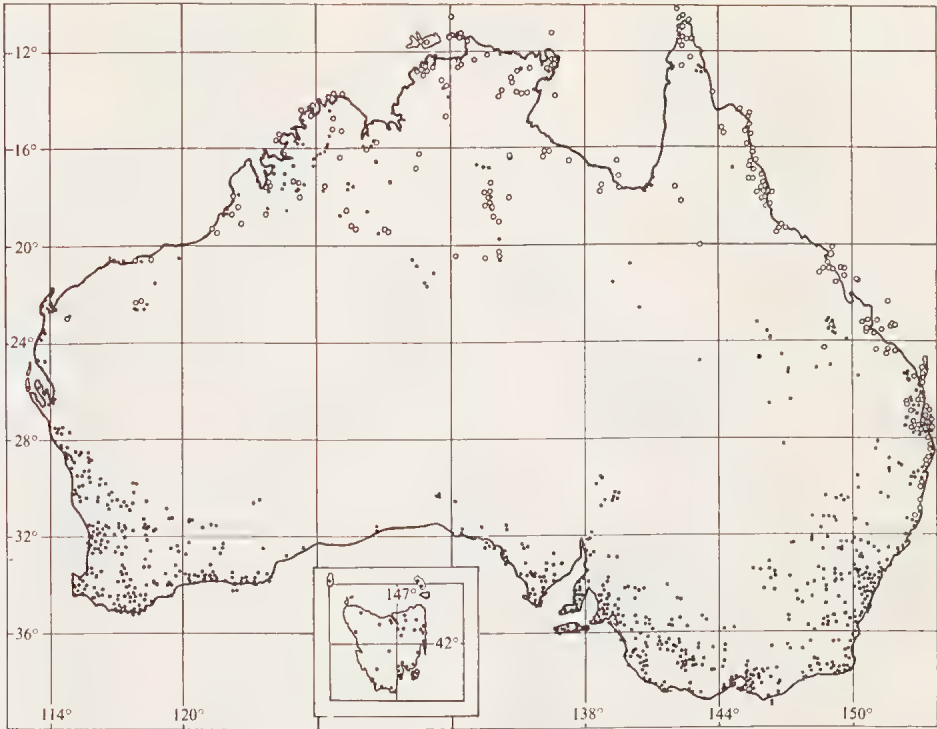
I have not seen any specimen which would comply with Nees' description in being a dioecious *Cassytha*, nor has the specimen cited by the author, *L. Preiss 1627*, from Western Australia, been seen.

Acknowledgements

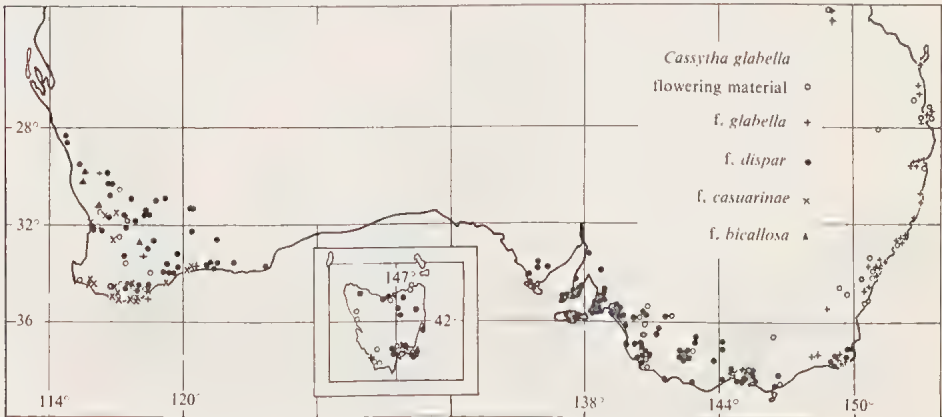
I would like to express my gratitude to many people who have assisted me in this project.

Particularly I would like to thank my supervisors, Dr D.C. Christophel and Dr J.P. Jessop for their comments on the draft of this manuscript and for help in detailed problems in this difficult genus. I am grateful to Dr H.J. Eichler, who suggested the project and enthusiastically forwarded some literature; to Mr L. Dutkiewitz for drawing the illustrations; to Miss B.A. Welling for typing the manuscript; to Mr A.C. Beaglehole for collecting specimens; and to Dr H. Tölken and the late Mr J. Carrick for assisting me with Latin diagnoses.

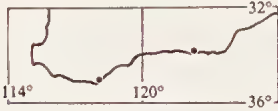
Thanks are also due to the Directors/Curators of the following institutions for the loan of Herbarium specimens: A, ADW, B, BM, BRI, CANB, FU, G, HAL, HBG, HO, JCT, K, Kings Park Perth, LY, M, MEL, NBG, NSW, NT, OXF, P, PERTH, PR, PRC, PRE, SYD, TCD.



Map 1. Distribution of *Cassytha filiformis* (circles) and of all other species (spots).



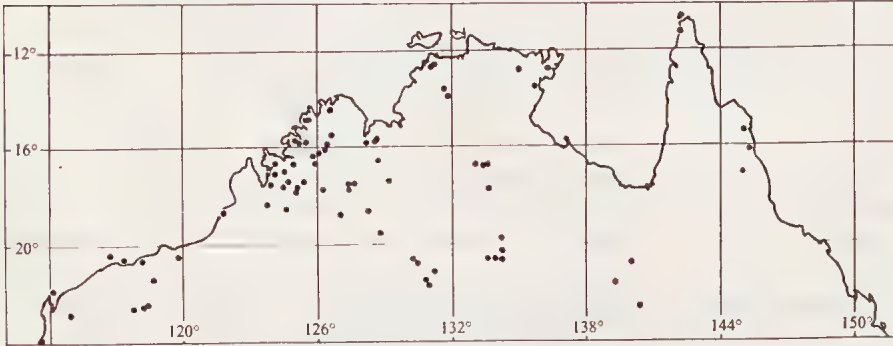
Map 2. Distribution of *Cassytha glabella*.



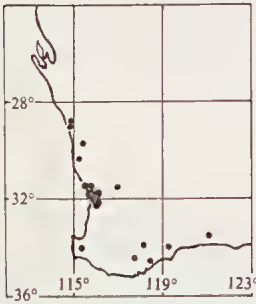
Map 3. Distribution of *Cassytha micrantha*.



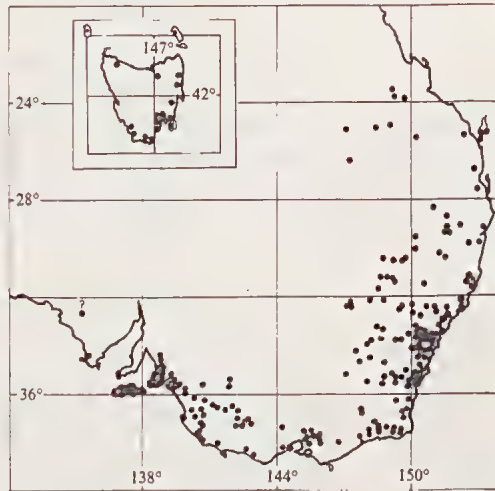
Map 4. Distribution of *Cassytha pedicellosa*.



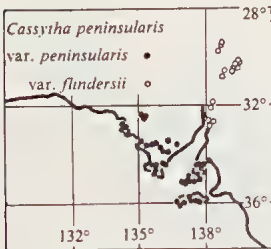
Map 5. Distribution of *Cassytha capillaris*.



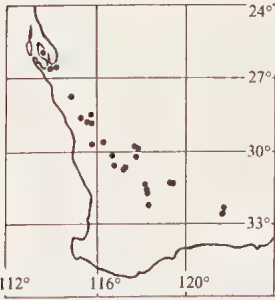
Map 6. Distribution of *Cassytha flava*.



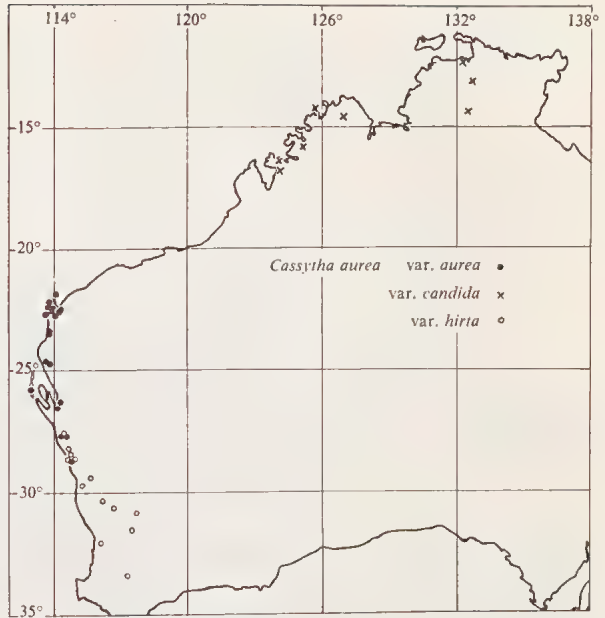
Map 7. Distribution of *Cassytha pubescens*.



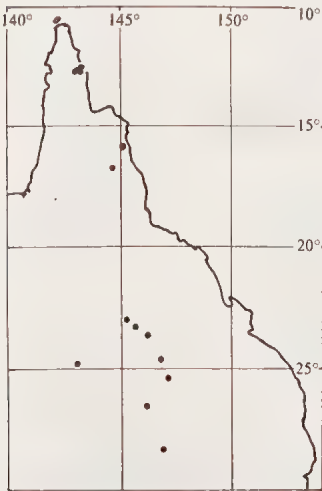
Map 8. Distribution of *Cassytha peninsularis* var. *peninsularis* (spots) and var. *flindersii* (circles).



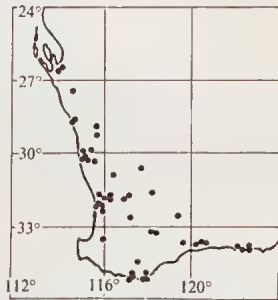
Map 9. Distribution of *Cassyltha nodiflora*.



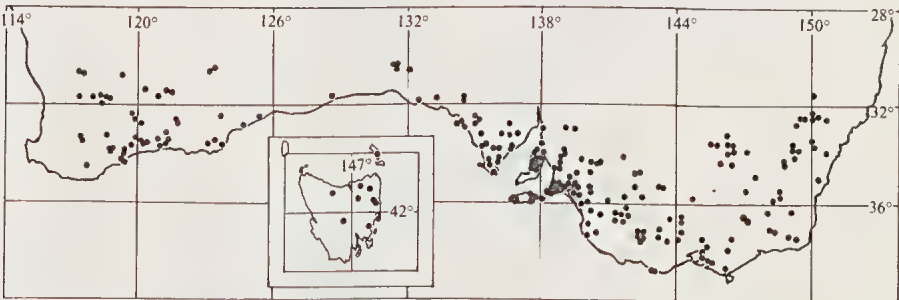
Map 10. Distribution of *Cassyltha aurea*.



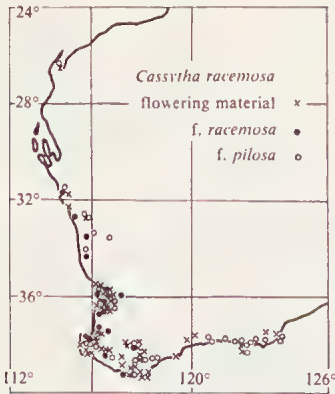
Map 11. Distribution of *Cassyltha rufa*.



Map 13. Distribution of *Cassyltha pomiformis*.



Map 12. Distribution of *Cassyltha melantha*.



Map 14. Distribution of *Cassytha racemosa* formae *racemosa* and *pilosa* and flowering material (not identifiable to forma).



Map 15. Distribution of *Cassytha racemosa* forma *muelleri*.

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